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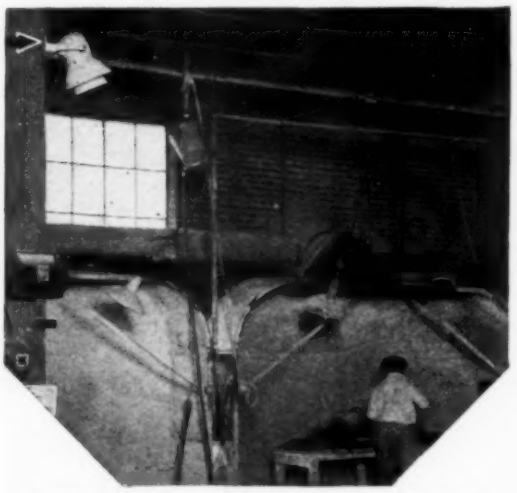
Castings Support Sirens for Industrial Signaling

YEARS ago, when many of today's large industrial concerns were in their infancy, the problem of sounding the signal for the plant to begin work was comparatively simple. A single whistle or bell could be heard easily throughout the plant and was sufficient to notify each employe of the time to begin work. As the floor space covered by the plant grew tremendously and the number of employes increased by the thousand, the old methods became inadequate. Quantity production methods, for which American industry has become famous, require that every



Sirens Are Placed in Various Plant Departments

man be in his place as the wheels of industry begin to turn. Today, many companies have replaced the single whistle or bell with sirens located in each department and controlled electrically from the clock in the main office. In addition to using the siren as a signal to start and stop work, it may be used as a fire signal, since the sound produced has sufficient volume and is sharp enough to be heard above the plant noises. Several manufacturers of electric sirens use a product of the foundry in the fabrication of their commodity. Since sirens require a substantial support, a cast iron frame is used for the purpose.

Find Where Castings Can Be Sold

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Superheats

By

Pat Dwyer

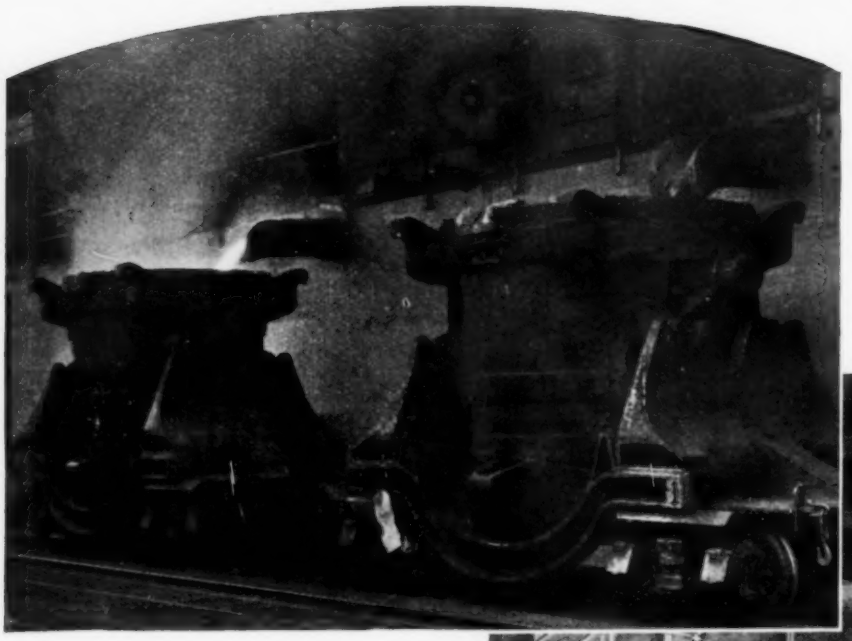


Fig. 1—Ladles Are Filled with Molten Iron Direct from the Blast Furnace

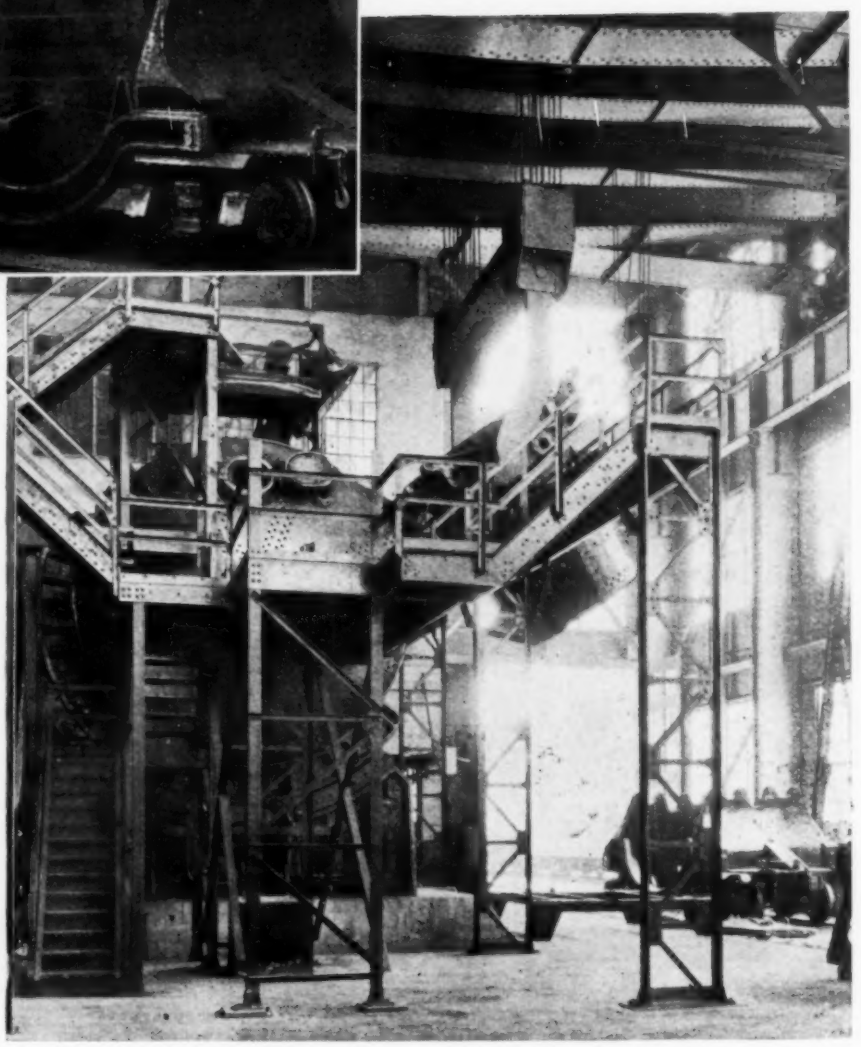


Fig. 2—Iron from the Blast Furnace and Iron from the Cupola Are Poured into the Large Mixer

PROBABLY at one time or another in his career, every foundryman engaged in melting large quantities of gray iron, has speculated on the possibility of utilizing iron direct from the blast furnace and thus cutting all the intermediate expense of casting in pig molds, stacking, shipping, weighing and remelting in the cupola. In some foundries, particularly those connected with large iron and steel plants, direct metal from the blast furnaces is used for pouring ingot molds, stools and many of the large rough castings employed about the plant either for new construction or repair. In a few instances courageous managers of plants engaged in the production of other lines of castings have spent considerable sums of money in trying to develop a method whereby a certain amount of direct metal could be added to cupola melted metal and used as a mixture in that manner. With one notable exception all these attempts have been abandoned either as impossible or uneconomical. Usually a combination of mechanical trouble and cold metal condemned the method and forced it into the discard.

One firm believer in the method, one man who has persisted in the use of direct metal in the foundry and a man who probably has gone farther than others along this line of research is Henry Ford. No figures are available on what the work has cost up to date. Even if the figures were available they would serve little purpose beyond satisfying idle curiosity. Approximately 2300 tons of molten iron have been poured daily for the past six years in the great continuous foundry at Fordson, Mich. and from one third to one half of this metal has been drawn from the adjacent blast furnaces. No other foundry in this country—or probably in the world—operates under anything like similar conditions, therefore if cost figures were avail-

Direct Metal Electrically *for Automobile Castings*

able they would be of little or no use as a basis of comparison.

History of the Ford industrial growth shows among many other interesting features that cost never was allowed to stand in the way of any project. In fact once the presiding genius of the organization set his mind on a definite goal, nothing was allowed to stand in the way until he achieved his purpose. The stickler for accuracy may point to one or two slips, but if the stickler in turn is pinned down he will have to admit that these slips did not happen in the industrial field where a highly trained and efficient organization responded to directing as readily as any symphony orchestra follows the baton of the conductor.

Many ideas cataloged by outsiders either as utterly impossible or at best as extremely radical have been pushed through to completion at a speed that left the doubters gasping. Even today some of the old guard have not succeeded in adjusting their minds to the fact that Ford inaugurated a new era in the industrial life of the country when he established a mass production factory in Detroit and paid his men a minimum wage of $5 a day. His theory—ridiculed and condemned at the time—that plenty of money in circulation makes for general prosperity has proved itself out in practice.

So it has been with many other innovations. Ford's nimble mind easily leaped to any desired goal and his organization usually arrived at the same point not long afterward. However occasionally he made a longer flight than

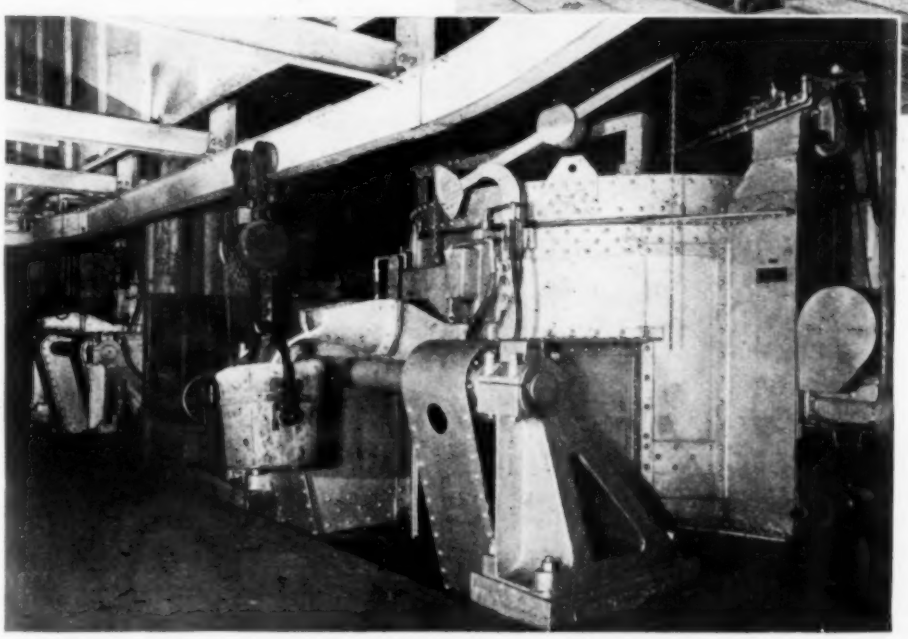


Fig. 3 (Left)—Iron is Superheated in the Electric Furnace and Ladles Suspended from a Monorail Are Employed To Take the Superheated Iron from the Furnace to the Various Pouring stations. Fig. 4 (Above)—Sixty Per Cent of the Iron Is Melted in the Cupola and 40 Per Cent Comes Direct from the Blast Furnace. Charging Boxes Are Loaded Automatically Under a Hopper and the Weight Recorded. Each of the Cupolas Is Provided with Two Doors and Loaded Cars May Be Routed on a Transfer Car to Either of the Doors on Either One of the Pair of Furnaces.

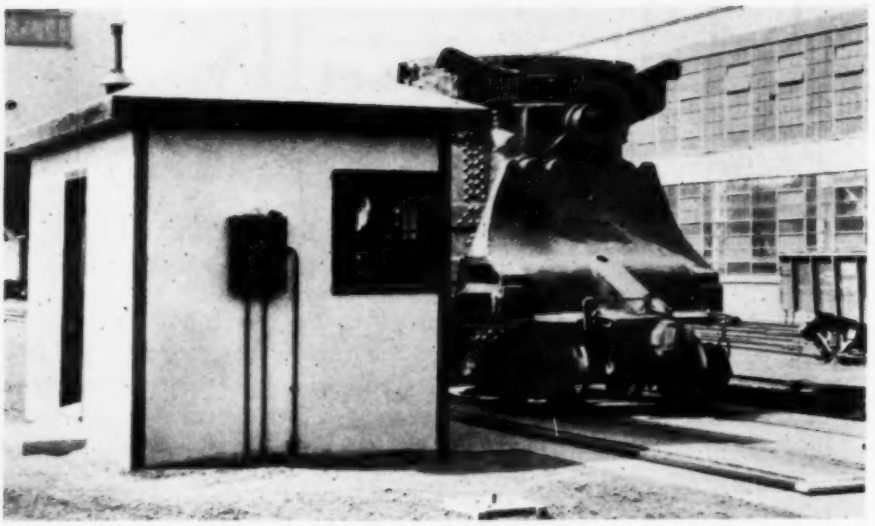


Fig. 5—Ladles Are Weighed on a Track Scale Before and After They Are Filled at the Blast Furnace or Cupola

usual, consequently a correspondingly longer period of time elapsed between the conception of the vision and its consummation. In planning the plant at Fordson, at that time known as River Rouge, Ford decided to eliminate all secondary melting of metal and to pour all the castings in the foundry direct from the blast furnace.

Anything Ford does or says—and in many instances doings and sayings that have no more substantial foundation than the fertile brain of a newspaper reporter—carry immense publicity value. They appeal to a greater number of readers than practically any other item of news. Under these circumstances it is only natural that statements occasionally are published more remarkable for enthusiasm than reliability.

For example when Ford claimed he was going to use metal in the foundry direct from the blast furnace every prominent newspaper in the country carried a story to the effect that Ford with characteristic ingenuity was going to revolutionize the foundry industry. He was pouring all his castings from a reservoir fed by a blast furnace and thus at one stroke had cut out all secondary melting in the cupola with a resulting economy in operating expense. He had done something which had been the dream of foundrymen for ages and no doubt his example soon would be followed universally.

As a plain matter of fact among the 10,000,000 cars that have been made since the Fordson plant started functioning, not a single one carries castings made exclusively from direct metal. Many of the castings have been poured from exclusively cupola melted iron and the remainder have been poured from a mixture of cupola and blast furnace iron ranging in proportion from 20 of the first to 80 of the second, to an even split of 50 per cent of each.

Substantial Progress Made

Attempt to utilize direct metal in the foundry represents one of the longest battles in the history of an organization famous for constantly doing the impossible. The battle is not yet over, but substantial progress has been made.

When the idea of using direct metal exclusively, first was proposed it was condemned out of hand unanimously by every foundry expert whose opinion was sought. With suitable secondary treatment they admitted the metal might be used while still in a molten condition, but no precedent was available to guide them in suggesting what form this secondary treatment should take. With a long list of impossible problems solved to his credit, Ford insisted on employing direct metal in the foundry and the task of developing a method was turned over casually to the engineering department.

Given a free hand and *carte blanche*, men from this department have upset tradition and custom in many manufacturing processes. They perfected a method of turning out plate glass in a continuous sheet in the face of the most positive declaration from highly skilled and highly technical glass experts that it could not be done. When they entered the foundry and picked up the direct metal problem they did not anticipate solving it off-hand. At the same time probably few if any of the first experimenters realized that the problem still would be unsolved six years later.

For all practical purpose the problem may be said to be solved in that a process has been developed to utilize metal from the blast furnace without remelting it. Technically the problem has not been solved in the sense that metal from the blast furnace may be poured directly into a mold to form a cylinder block or any other casting used in an automobile.

In the process lately placed in force, blast furnace metal and cupola metal in the approximate proportion

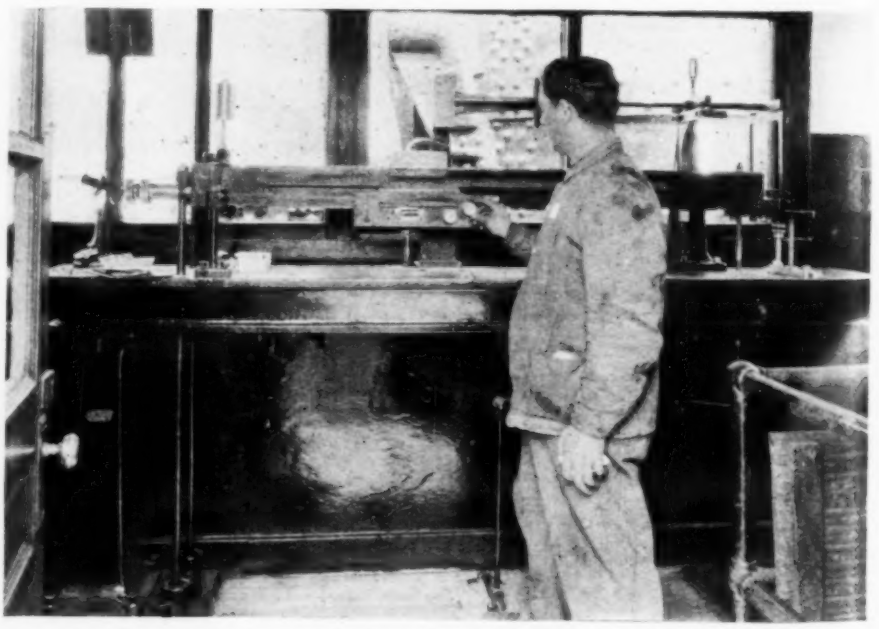


Fig. 6—An Accurate Record Is Kept of All the Metal Either from the Blast Furnace or Cupola That Passes Over the Scale on Its Way to the Mixer

of 40 per cent of the former to 60 per cent of the latter are poured into a 400-ton mixer. From the mixer the metal is removed 15 tons at a time and dumped into an electric furnace where it is raised to a proper pouring temperature. It is taken from the electric furnace in 1-ton ladles and distributed by monorail to the various pouring stations.

Failing in the original attempt to pour cylinder castings direct from blast furnace iron, a compromise was effected whereby cupola metal and direct metal were mixed before the iron was poured into the molds. The method was described in considerable detail in the Oct. 1, 1921 issue of THE FOUNDRY and may be described briefly as follows: A supply of hot metal from the blast furnace was kept in a receiver in the foundry. A certain amount of this metal, depending on the analysis and the temperature, was weighed into each of the pouring ladles and the remainder of the ladle was filled under the spout of any one of 36 cupolas with exceedingly hot iron. This mixture of iron then was poured into the molds.

Encounter Some Difficulty

While this method was fairly satisfactory it did not measure up to expectations and sometimes caused trouble on account of the impossibility of synchronizing temperature and analysis. For example on a theoretical 50-50 basis the analysis would be correct. If the blast furnace metal was cold, necessitating the addition of 60 or even 70 per cent hot cupola metal, it is apparent that the resulting castings would differ widely in analysis from castings poured at other periods of the day when hot metal from the mixer could be used with cupola melted metal in the theoretical 50-50 proportion.

Recently an improved method has been adopted and a single unit of equipment has been installed capable of treating approximately 40 tons of metal per hour. Based on the success of this unit in meeting requirements on the restricted operating schedule which has prevailed for the past few months in the Fordson plant, plans already are under way for a duplicate unit and eventually for a third unit which will take care of a maximum production of 120 tons per hour on a 24-hour schedule.

The new method insures absolute uniformity of temperature and analysis. All the variables have been removed. Only in one point does it fail to meet the dictum laid down originally by the modern Aaron whose magic wand never yet has failed to draw water from the solid rock. "Find a way" he said "to pour metal direct from the blast furnace into the molds without any intermediate remelting."

This is being done at present, but it only is being done to the extent of 40 per cent. The remaining 60 per cent of the metal poured in the foundry is melted in the cupola from cold stock. Some day perhaps a method will be developed for passing blast furnace metal through an open hearth furnace where it will be raised to a suitable pouring temperature and where the various elements may be adjusted to meet the required analysis.

This idea still is in the embryo stage and nothing has been done toward designing equipment to test it out on a practcial basis. Theoretically the idea presents a certain appeal, but from an operating standpoint the present method apparently is more desirable and is giving satisfaction.

On a conservative estimate, defective castings, gates, sprues and miscellaneous scrap amount to 25 per cent of the total amount of iron melted, or approximately 600 tons per day. Manifestly, the logical method of disposing of this large accumulation of scrap is to remelt it day by day. Melted by itself the silicon content of the iron is too low for automobile engine castings. The silicon content in blast furnace metal is too high for the same purpose. A judicial mixture of the two gives the correct analysis, takes care of all the scrap and permits the utilization of all the iron from two blast furnaces, approximately 1000 tons per day. The scrap, of course is not confined to foundry remelt. Steel scrap and miscellaneous cast iron scrap from all over the plant is available at all times in any desired amount.

General layout of the equipment in the new building erected to house the new process is shown in Fig. 9. The empty space at the left eventu-

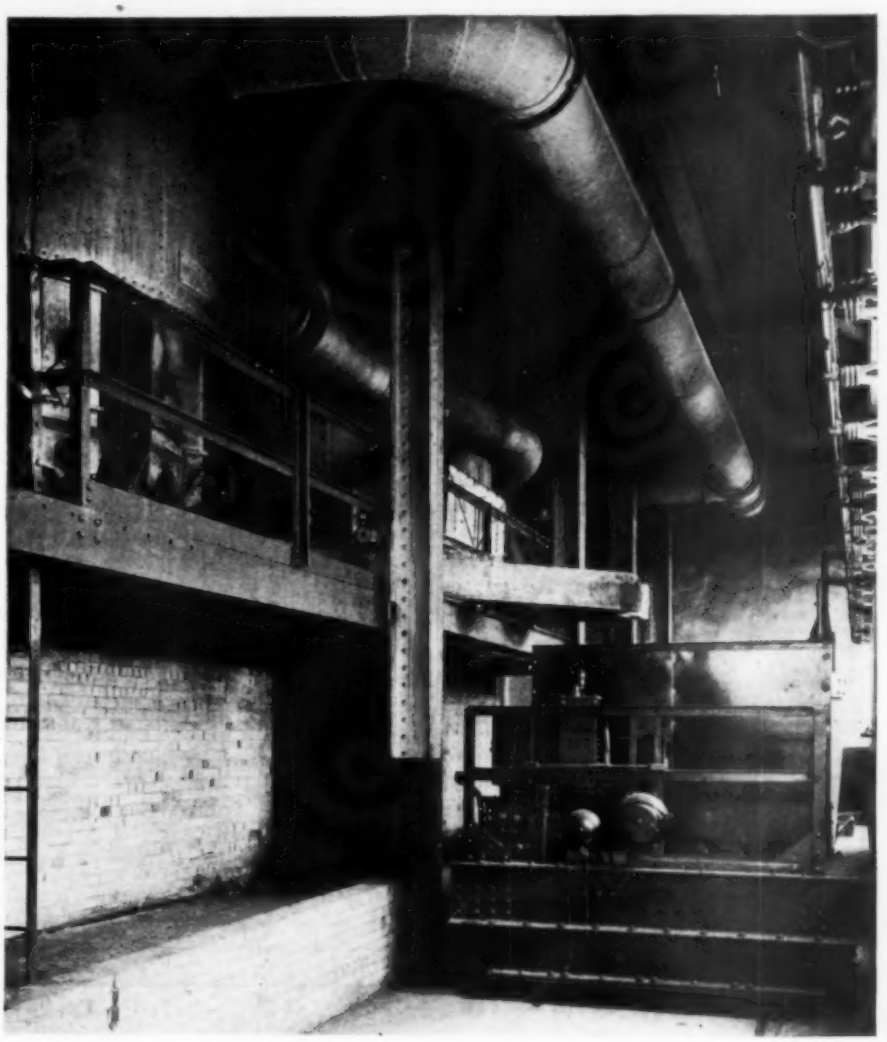


Fig. 7—Spouts from the Two Cupolas Converge to a Common Point and Discharge Molten Iron into the Transfer Ladle which Conveys It to the Mixer

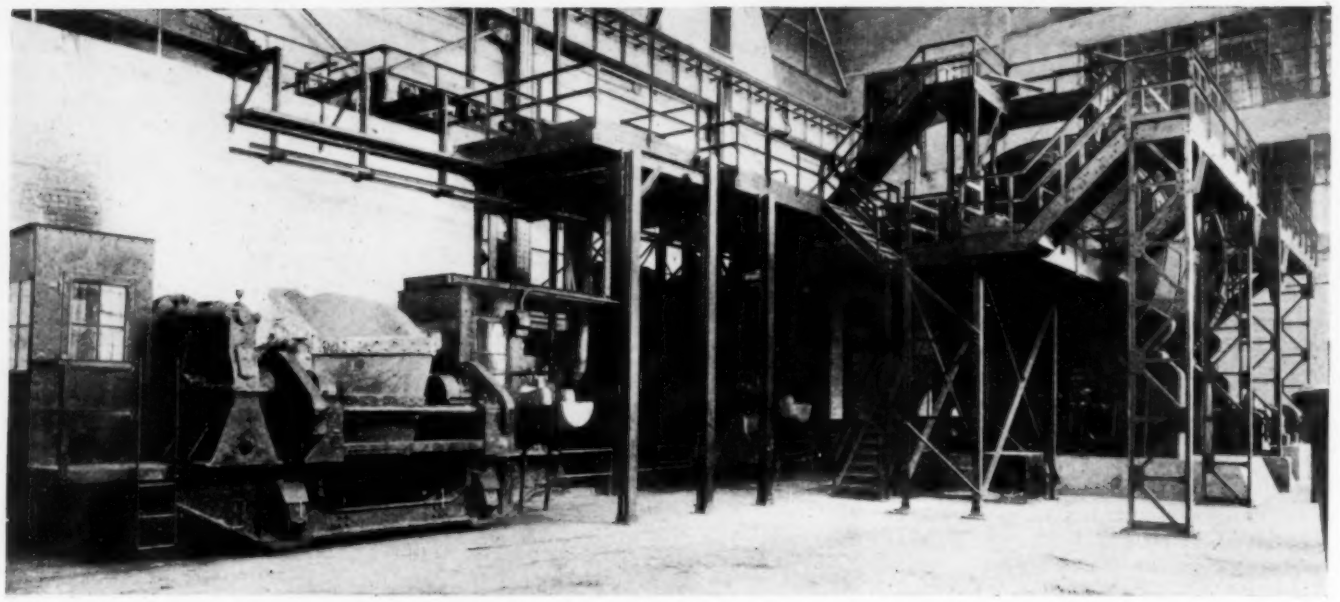


Fig. 8—Metal from the 400-ton Mixer Is Taken in the Transfer Ladle and Poured into Two Electric Furnaces Where the Temperature Is Raised Approximately 250 Degrees Fahr.

ally will be occupied by a second unit similar to the first. Later if conditions warrant and if a better method has not been developed in the meantime, one or more similar units may be established in the same general vicinity. Possibly also the electric furnaces will be of larger capacity. The present description is confined to the equipment at present in operation.

The central feature of the present system is a cylindrical steel vessel, lined with brick, heated by oil, resting on two steel cradles after the manner of a tilting open-hearth furnace and with a capacity of 400 tons. The general appearance of this mixer is shown in Figs. 2 and 8 while its position in regard to the other items of auxiliary metal handling equipment is shown in Fig. 9. Hot metal from the blast furnace comes in on one track as shown. Hot metal from the cupolas is brought in on a second track and the metal from both sources is poured into the mixer by an overhead traveling crane.

A locomotive is employed to shunt the ladles forward and backward between the mixer and the blast furnace. The ladle between the cupolas and the mixer is conveyed on a special truck electrically operated. A similar carriage and ladle shown to the left in Fig. 8 is employed to transfer the metal from the mixer to the two electric furnaces.

With the temperature element removed it is apparent that mixing the iron from the blast furnace and cupola to show a certain silicon content is a simple operation. On ac-

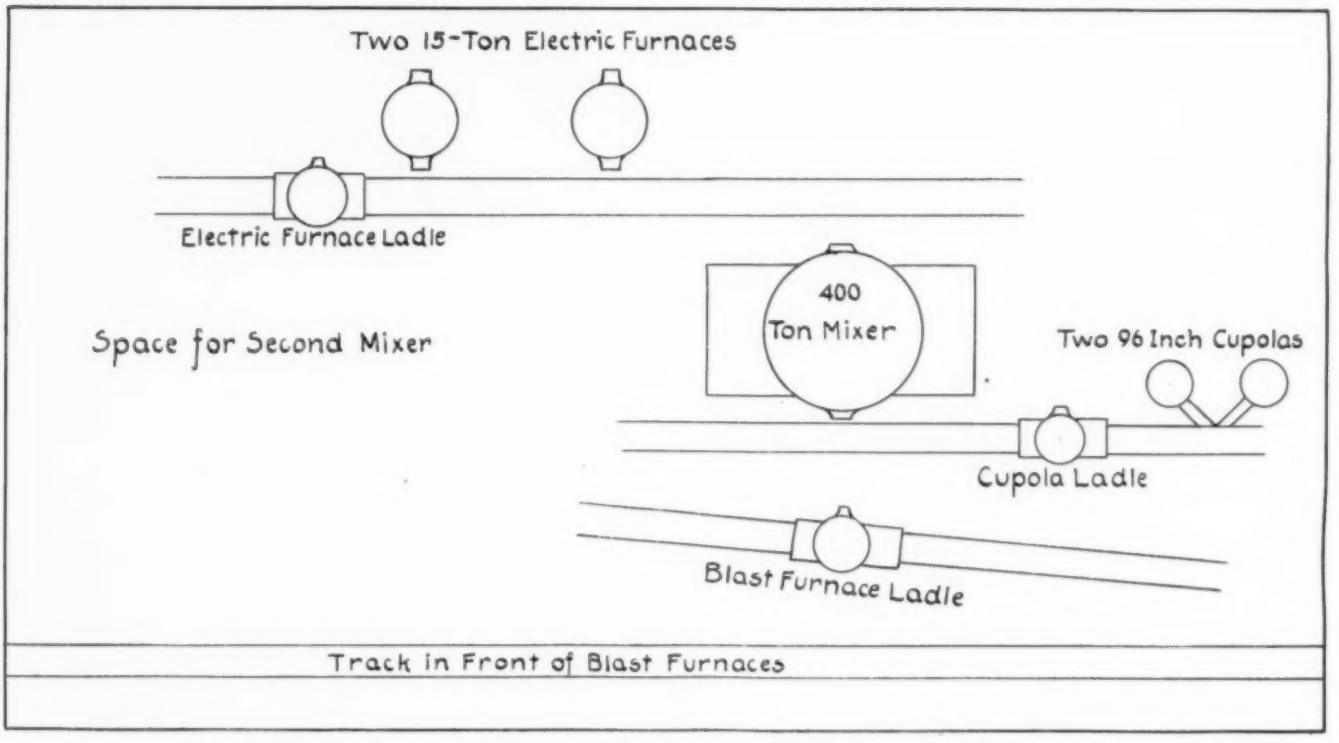


Fig. 9—General Layout of the Different Pieces of Equipment Employed in the Duplexing Process where Direct Metal and Cupola Melted Metal Are Mixed and Afterward Superheated

count of the character of the metal it is found that after the silicon content has been brought to the proper point, the remaining elements in the iron automatically have adjusted themselves. Where the silicon is running extra high in the blast furnace iron, a greater amount of low silicon cupola iron must be added to the charge in the mixer. Where the silicon is comparatively low in the blast furnace iron, the amount of cupola iron needed in the mixture is decreased. Tests are taken from every tap at the blast furnace and at the cupola and with this data the relative amount of each class of metal easily is determined.

Calculate Silicon

Allowing for the usual variations from time to time, the anticipated silicon content of the blast furnace iron is 3.50 per cent while that from the cupola is 1.00 per cent. Required silicon in the castings is 2.00 per cent. From the foregoing data it is readily apparent that a 60-40 mixture will yield iron of the required analysis. 60 per cent of a 400-ton charge is 240 tons. 240 tons x 1.00 per cent silicon = 240.00. In the same manner 160 tons (40 per cent of 400) x 3.50 = 560.00. By adding the two together, 240.00 + 560.00 = 800.00 and then dividing this by the total 400, thus, 800.00 ÷ 400, the result is the desired 2.00 per cent. Exact weight and analysis of every ladle full of iron is recorded, therefore no trouble is experienced maintaining a constant uniform iron in the mixer. A slight adjustment in the volume from the two sources, works a corresponding change in the silicon content of the combinaton.

The foregoing represents the first stage of a duplex process where iron from the blast furnace and iron from the cupola are mixed in large quantities and under perfect control. In the second stage this homogeneous iron is taken 15 tons at a time and placed in an electric furnace where the sluggish metal is raised to a suitable pouring temperature. The pouring spout of the electric furnace occupies a similar position to one of the cupolas formerly employed, therefore the same facilities are employed in taking the iron from the furnace and distributing it to the pouring stations as before the electric furnace was installed.

While the plant was working on a greatly reduced scale recently the mixer was filled at night and received no further additions of metal during the day. The required amount of blast furnace metal was taken from two taps 6 hours apart. The cupola was kept in blast from 11 p. m. until 7 the following a. m. and during that time was tapped at the approximate rate of 30 tons per hour.

Beyond the fact that everything is kept immaculately clean in the vicinity of the blast furnaces and ladles, the method of operation does not differ radically from that in other plants. The brick floor around the stack is swept as clean and smooth as the spotless and shining floor of the typical Dutch kitchen. The bustle pipe and goosenecks, chaste and modest in a coat of aluminum paint convey an impression of peace, hard to reconcile with a knowledge of the red hot blast pouring through the inside. An attendant spends a considerable part of his time creeping around the beams and rafters, blowing down all the graphite and other dust with an air hose. After each tap the mud gun is wiped and polished and every speck of clay is cleaned away from the vicinity of the tap hole. The runner in the floor leading from the tap hole to the spout in the outside wall over the ladles, is brushed up as slick and smooth as any runner cut in the drag face of a dry sand mold. Absolute cleanliness, whether inherited, or acquired during his engineering days, is one of Ford's pet hobbies and is in evidence every place from the magnificent power house at the Highland Park plant to the scrap pile at Fordson where the chopped up remains of 100 ships of the emergency fleet await their turn to go through the open hearth furnaces.

Special Cupolas

Many interesting features characterize the cupolas used in connection with the blast furnace in the duplex process of converting direct metal into castings. It is claimed the two cupolas at present in use are the largest in existence. Inside diameter of the shell is 120 inches while the diameter inside the brick lining is 96 inches. The melting capacity of each is given as approximately 30 tons per hour. At present only one cupola is in use part of the time. Eventually the two cupolas will be used full time on alternate days. Spouts from the two cupolas converge to a common point so that when and if necessary, both cupolas may be tapped into one ladle at the same time. The transfer car and ladle in position under the spouts are shown in Fig. 7.

Mechanical equipment has displaced manual labor almost entirely on these cupolas. Coke is brought from the coke ovens on a conveyor and stored in bunkers under the roof. An attendant moves a lever to fill the charging pan set under one of the enclosed chutes leading down from the coke storage. Scrap from the foundry and from outside sources is brought by conveyor and discharged into a number of concrete bins in the stock yard according to its classification. A magnet attached to a crane lifts this scrap and drops it on a moving conveyor which discharges it into a number of bins above the charging floor. From the bins it is dropped like the coke into the charging boxes.

Use Iron and Steel

Iron charges are made up in the proportion of 70 per cent scrap iron and 30 per cent steel scrap. The actual weight is 2800 pounds of iron scrap and 1200 pounds steel in each 4000-pound charge. Each cupola is provided with two charging doors opposite each other through which the charges are dumped by mechanical tipping devices operated by compressed air. The attendants on the charging floor push the loaded cars from under the chutes to the charging devices in front of the doors. Then they push the empty cars back again under the chutes. All the other work incident to charging the cupolas is done mechanically. A view of part of the charging floor, one of the cupolas and two of the hoppers under which the scrap cars are loaded, are shown in Fig. 4. A scale at each station is used to keep a check on the amount of scrap placed in each charging box. Between charges, also when the furnace is idle, the doorways are guarded to prevent any accident. A steel frame with a steel chain mesh on the lower part is suspended from a suitable support and is raised and lowered by a small air hoist attached horizontally to the same beam from which the door is suspended.

By keeping close check on the weight of the metal at three stages the chance of error practically is eliminated. Thus the scrap is weighed before it is placed in the cupola. Each ladle of molten metal from the cupola and each ladle from the blast furnace is weighed on the track scale shown in Figs. 5 and 6 before it is poured into the mixer. Finally each ladle of metal removed from the mixer is weighed on a second track scale located on the pouring side of the mixer and with the recording mechanism on the mixer platform close to the electric controls.

The safety feature which goes hand in hand with cleanliness through the various Ford establishments finds new

(*Concluded on Page* 737)

Analyzes Four Hundred Tons of Defective Castings

Thorough Study of Scrap Heap in a Gray Iron Foundry Reveals Points of Weakness in the Various Operations

By J. M. Haley

PRODUCTION of a maximum percentage of better castings at a minimum of expense is the ultimate end of foundry research. Control of raw materials such as molding sand, coke, and limestone, control of cupola charges, and pouring temperatures are useful in so far as they assist in the attainment of a lower percentage of defectives and a better product. It is an undisputed fact that scientific control and foundry research has, in no small measure, brought about material reduction in foundry losses. It is exemplified concretely in the foundry records of those concerns who have definitely promoted its advancement. However, it is, a much mooted question among many as to just how much may be expected by expenditures in this direction and just wherein lies the key to the proper direction and line of attack.

A thorough analysis of the scrap heap or the defectives, is the index by which concentrated energy may be expended. Segregation of defects, and classifications of these, relative to the source of complaint, enable coordination of thought and proper allocation of expenditures. Each particular foundry has its individual problems. Lack of floor space, inability to correlate molding floors and cupola with straight line production methods, extreme variability of casting shape and weight, and impossibility of standardization are some of the specific difficulties which prohibit many existing foundries from applying to themselves the advanced methods of modern procedure. It is quite evident that a foundry, situated to encounter continually the above difficulties, cannot utilize to the fullest extent those ideas and developments which contribute so materially toward more efficient operation in modern buildings.

It is by scrap heap analysis and by the reduction of the scrap heap to a minimum that foundry control may be so exercised that these foundrymen are able to cope with the competitors who are not confined to the above limits. Defective castings not only play an important role so far as foundry expense is concerned, but an excessive percentage of loss is generally havoc-raising to shop production.

A study of conditions in a gray iron foundry, the average production of which approximates 80 tons per day, has revealed interesting data. Castings vary from one ounce to 6000 pounds. These must stand wear and yet be easily machineable, so they will not hamper machine shop production. To fully study foundry conditions and establish a working foundation, the scrap castings were classified as shown in Table I.

J. M. HALEY, foundry technologist, Crompton & Knowles Loom Works, Worcester, Mass., received his early education in the high school at West Warren, Mass. He was graduated from Holy Cross college, Worcester, in 1923, receiving a degree of bachelor of arts. After graduation he became affiliated with the Crompton & Knowles company. This article is abstracted from a paper by Mr. Haley, which was presented at the Chicago convention of the American Foundrymen's association, June 6-10.

The analysis of four hundred tons of defective castings gave the results shown in Table II.

Figs. 1 and 2 are charts showing the variation of defective castings of the various classifications, week by week, for a period of 16 weeks.

A study of these charts clearly shows the tendencies of the total scrap. It follows closely the total defective molding. Shrinkage and dirty castings do not vary materially. The graph of Fig. 2 shows the reason for the variance in the molders' defects. It varies directly as the molders' miscellaneous. In other words, the erratic percentages are due to the human element.

Over 50 per cent of the total defectives chargeable as molders' defects fall into the miscellaneous column and are attributed to the molder himself. The human element is a factor which, to a large extent, is uncontrollable. The inherent and overpowering desire to put up a few more flasks, at the expense of insuring each and every one to be clean, is a source of large loss in every production shop. The type of man who is employed in the foundry is not the artisan of former years; he is, rather, the ordinary common laborer whose vision centers on his wages. His actions are mechanical. His thoughts are measured by the quantity and not the quality of work accomplished. The exercise of care is submerged by the powerful impetus of speed. The problem involved in the elimination or reduction of this factor is an educational problem. It lies within the scope of the foremen to instruct and relay to these men that necessary care and pride in their work.

Approximately 22 per cent of the total molding defects, or 15 per cent of the total scrap, is classified as cuts, drops and blows. The reasons for cuts, drops and blows may be attached fairly to molding sand ills. Lack of bonding material is responsible for drops. An excessively low permeability or high moisture content in tempering is a prolific source of blows. The quality of the bonding material has a direct bearing on the ability of the sand to withstand the cutting and washing action of the molten metal.

It is not intended to discuss the different properties of molding sand and their relation to the quality of the molders' heap. However, the use of sand testing apparatus is of proved value in the rectification of the complaints listed. Experiments have shown definitely that a material reduction may be effected by proper

manipulation and control. There are numerous examples of the benefits which have accrued. Investigation of those floors which were experiencing a large percentage of cuts and washes showed low values so far as dry sand strength was concerned. By taking the sand heap to a mulling machine, incorporating new sand and clay additions, thoroughly mixing and aerating, a decided increase in dry sand strength was obtained. Checking up in the foundry, it was found that these troubles were eliminated by this procedure.

Invariably, investigation of the properties of the molding sand yielded gratifying results. Troubles which have been mentioned had their remedy in proper consideration and correlation of sand testing to foundry practice. So far as blows are concerned, an increase in permeability will tend to make the sand more *fool proof*. Incorrect tempering and wet spots in the sand are again a factor of the human element and an educational program in conjunction with moisture determinations will bring about desired results.

Further analysis of the scrap heap reveals that 22.4 per cent of the molders' defects, or 15 per cent of the total defects, is attributed to coldshuts and misruns. Concentrated study of these items showed a certain class of castings that appeared regularly. These castings were thin sectioned or were thin sectioned adjoined to a heavy section. Coldshuts and misruns may be due to dull iron, improper gating or shape of castings. Occasions have arisen where men have poured iron which was being returned to the cupola. Although the molder knows differently, the desire to have his work poured may overcome his better judgment and cause the loss of castings.

Shrinkage amounts to about 7 per cent of the total scrap. This is made up of contraction, cracks and shrink holes, especially in cored places. Analysis of this item indicated that the volume of shrinkage occurred in a certain class of castings that was a chronic offender. Just as regularly as these types went into the foundry, trouble was experienced. The cracks invariably were found in castings, the design of which was such that a heavy rim adjoined a light arm and heavy hub. The arms generally would pull away from the rim. Excessive losses from this source were experienced until a change in the design was made.

It is an undisputed fact that many castings are lost in the engineering department. Faulty design is an ill which takes an enormous toll of defective castings. Much time and energy often are employed in the foundry in an attempt to rectify a condition, the solution of which is an engineering proposition. A close relationship between the foundry organization and designers absolutely is essential for the production of intricate castings with the least amount of defectives. It should not be assumed that a casting, as designed, is not to be questioned. However, it should be recognized, that there are many opportunities for faulty design, if a competent foundryman is not consulted.

So far as shrink holes were concerned, analysis of the scrap heap showed a problem of the same nature, namely, periodic offenders. Hence, an intensive survey of the defective castings enables proper attention to be given to those specific chronic offenders, which often constitute the biggest majority of defectives.

The third major item was that of dirty castings. This item totaled approximately 18 per cent of the defectives. This class of castings again revealed a problem of chronic offenders. Not only were certain castings troublesome, but investigation disclosed the fact that the majority of these castings came from a certain number of molders. Occasionally, there would be a general period of dirty castings throughout the entire shop, but usually the one group of molders making a particular casting was the source of difficulty. The big problem was to determine, where the dirt came from. The coke and iron invariably are blamed, whereas the trouble is in faulty molding practice. The positions, the types and particularly the sizes of the gates and risers are responsible in the majority of cases where trouble of this kind is encountered. Iron will come from the cupola with a certain amount of kish and slag. It is a necessary evil attendant with cupola practice.

The cupola is a cheap economical process of melting and a high degree of refinement cannot be expected from it. On many occasions, the line of least resistance is to say that the correction of evils is in a change of the cupola practice. However, it must be understood, that any such change is limited by the limits of the cupola itself. Metallurgical control and operation of the cupola can go no farther than to say the pig iron, the coke and limestone adhere to specifications, the blast pressure and volume are satisfactory. Operation is limited to the knowledge that the materials are charged properly, and that the ratio of coke is adequate. The accumulation of slag is incidental to operation. For the prevention of dirty castings, it should be incumbent upon the molder to see that this slag does not enter the molds. This is done by skimming or straining or by properly sized gates and runners. Satisfactory proof as yet has not been given that gases picked up in the cupola are primal causes of gas holes in the casting. It is more reasonable to say that gases generated from the

Table II

Loss Allocations

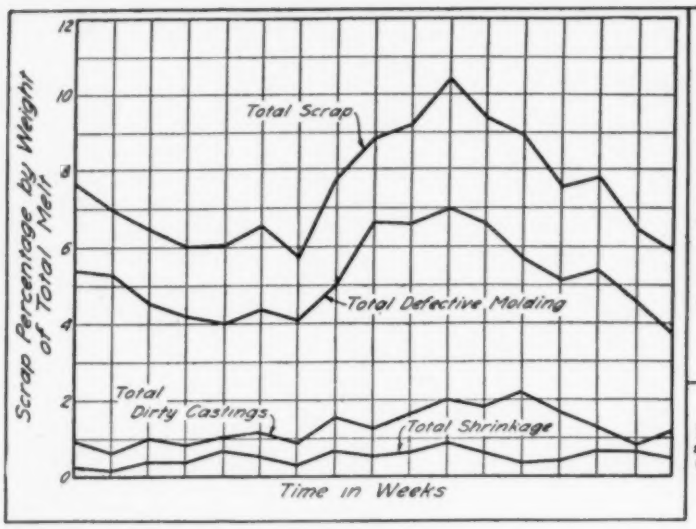
A. Foundry
1. Molders' Defects
   - (a) Cuts
   - (b) Drops
   - (c) Blows
   - (d) Not Run
   - (e) Coldshut
   - (f) Miscellaneous
     - (Core off center)
     - (Core crushed)
     - (Core tipped)
     - (Flask shucked)
     - (Strain)
     - (Bad patching)
     - (Runout)
     - (Core left out)
     - (Scabs)
     - (Hard ramming)
2. Shrinkage
   - (a) Shrink cavities
   - (b) Shrink cracks
3. Dirty Castings
   - (a) Sand inclusions
   - (b) Slag inclusions
4. Foundry Breakage

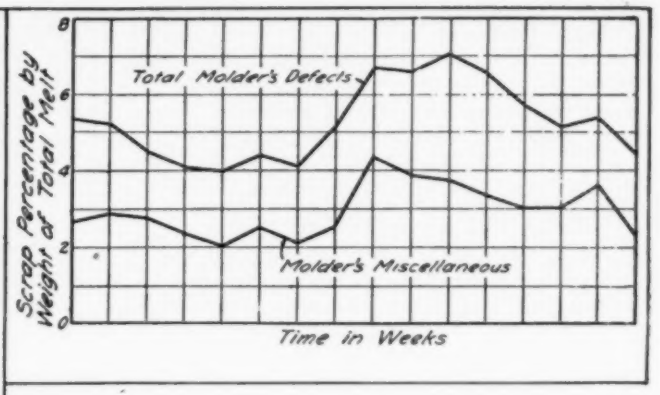
B. Machine Shop
1. Porosity
2. Dirt Inclusions
3. Blow Holes
4. Hard Iron

Table I

Analysis of Defective Castings

1.	Molders' Defects, by weight:	
	(a) Cuts	2.35 per cent
	(b) Drops	7.92 per cent
	(c) Blows	5.00 per cent
	(d) Not run	7.30 per cent
	(e) Coldshut	8.13 per cent
	(f) Miscellaneous	38.10 per cent
	Total Molders' Defects	68.8 per cent
2.	Shrinkage	6.9 per cent
3.	Dirty Castings	17.4 per cent
4.	Foundry Breakage	6.9 per cent
	Total	100.0 per cent





Figs. 1 and 2—Variation of Defective Castings Over a Period of 16 Weeks

cores and from the molds themselves are responsible for many troubles of such a nature.

In the attempt to correlate defectives with the chemical analysis of the iron, at no time was sufficient variation found to warrant the assertion that a few points change in silicon or sulphur would cause erratic production. It is impossible to purchase pig iron within closer limits than plus or minus 0.25 silicon. Accordingly it is logical to say that the chemical analysis of the casting cannot be controlled, except within corresponding relative limits.

Investigation of defectives returned from the machine shop proves a fertile field. Poor service records for cutters, the burning of tools and other similar complaints, often constitute a serious charge against iron quality. Hard iron, in many cases, is a mythical charge. Invariably, laboratory examination discloses the fact that the iron could be classified as readily machineable. Brinell hardness values and structure disclaimed charges of hardness. Chemical analysis indicated proper percentages of the different constituents. It was found by checking machine shop practice that the speeds and feeds were greatly in excess of recommended practice. By proper adjustment of these factors and by intensive study, the hard iron charges became a matter of slight concern. Not only were speeds and feeds subject to correction, but it was found in many instances that the castings had not been cleaned properly. Burnt sand adhering in corners and crevices was a factor causing machine tool difficulty. Upon the exercise of more care in the cleaning room, this complaint disappeared.

The vast amount of direct constructive development which results from proper segregation and intensive study of the different constituents of the scrap heap are of paramount importance. Waste is a matter of growing concern to industry in general. The government is taking precautionary measures. It must be recognized in the solution that the human element is a most vital factor. The entire personnel of an organization must be educated to conservation and reclamation. Executives and superintendents must recognize the necessity of adhering to outlines and drafts made available by technical experts. The laborers themselves must take cognizance of the loss encountered in spoiled material and useless labor. With particular reference to foundry conditions, the scrap heap analysis is a workable index to efficient operation. It might be called the barometer of efficient production. By intimate knowledge of its parts, information is readily available whereby the foundryman may direct and concentrate forces toward the reduction to a minimum of those castings which are perennial offenders.

Book Review

Foremanship, by Glenn L. Gardiner, 680 pages, 5½ x 8 inches, cloth, published by the A. W. Shaw Co., Chicago, and supplied by THE FOUNDRY, Cleveland for $6.00; in London, Caxton House, Westminster, for 30s.

Any manufacturer knows how much depends upon the foremen. A poor foreman in one department may limit production to a great degree, not through malicious design, but because he lacks the training which makes him realize the position of his department with relation to the other departments in following the production schedule. The foreman not only should understand the technical duties of his position, but also he should be able to obtain the good will and co-operation of his men which tends to give a smooth working department.

Various aspects relating to good foremanship and the relation of the foreman to the plant as a whole form the subject matter of this new book. The volume is divided into six parts. The first is devoted to the foreman, the second to the foreman's job, the third to the duties of a foreman, the fourth to developing foremen, the fifth to practical methods, and the sixth to industrial economics. The author outlines in detail the numerous factors and gives practical illustrations to emphasize his points. Foremen or other interested persons will find it worthwhile to read this book. Not only will they obtain valuable information, but also will be surprised at the diverse character and wide ramifications of foremanship.

Welders Will Meet

A conference embracing all phases of the welding industry will be held at the University of Minnesota, Minneapolis, on Oct. 20, 21 and 22, according to plans worked out by Prof. S. C. Shipley, acting head, mechanical engineering department, college of engineering. This will be the first conference of this nature held by the University of Minnesota. A large part of the conference will be devoted to papers by practical users as well as to round table discussions led by experts in their respective lines.

Appoints New Agents

The Harnischfeger Corp., Milwaukee, has appointed the Johnson-Beckwith Equipment Co., Davenport, Iowa, as representative in the Davenport territory. The Northwest Equipment Co., Billings, Mont., has been assigned the Montana territory.

The American Radiator Co., Buffalo, has removed its purchasing department from Buffalo to New York.

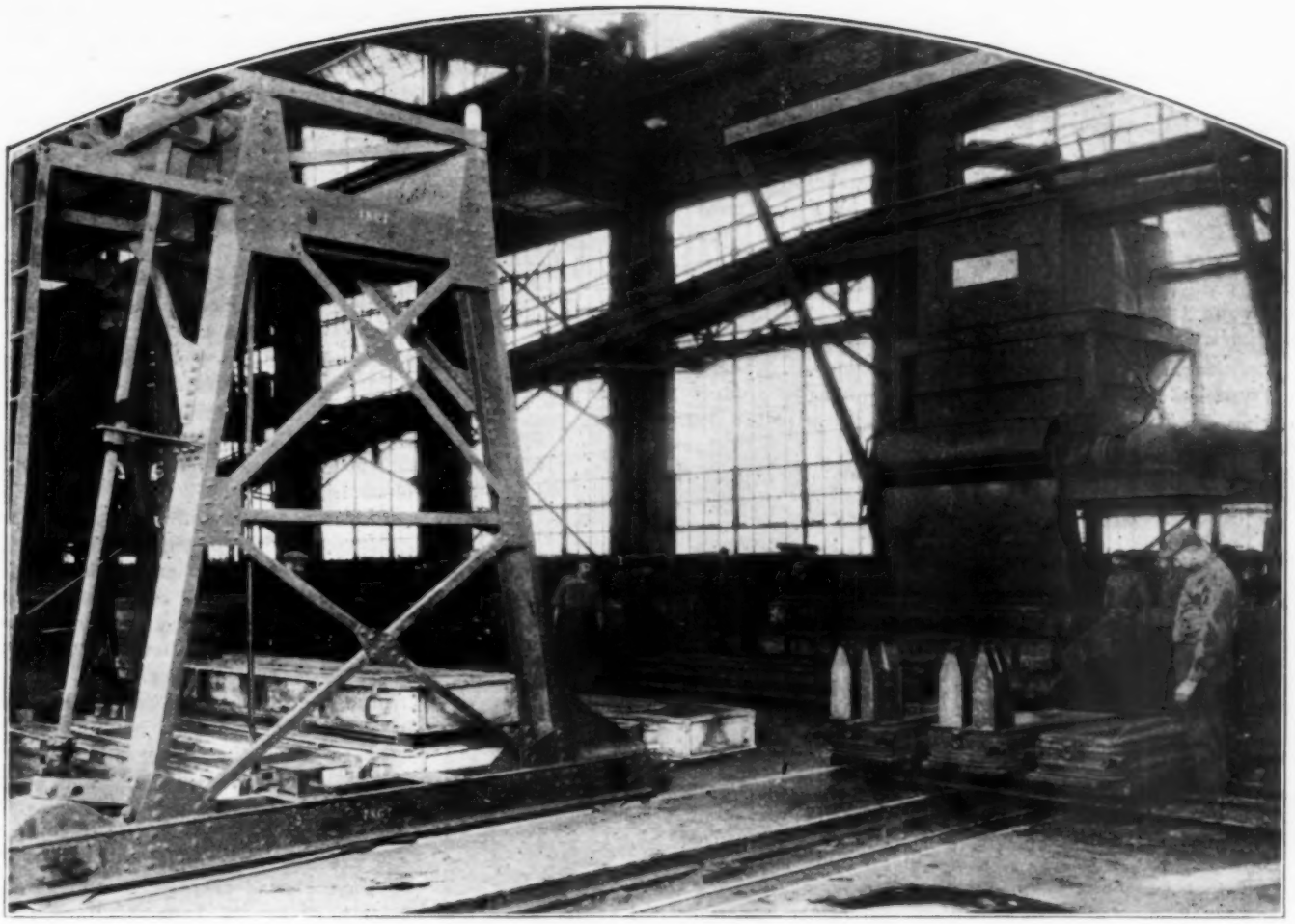


Fig. 1—General View of Equipment Used to Make Molds for Manganese Steel Frogs and Switches

Produces Track Specialties *with Modern Equipment*

By Frank G. Steinebach

DURING the second week of June two mighty railroad systems celebrated the twenty-fifth anniversary of the first 20-hour trains between New York and Chicago. In the summer of 1902, the Twentieth Century Limited, crack train of the New York Central lines, and the Broadway Limited, the finest train operated by the Pennsylvania system, pulled out of Chicago and New York on their initial runs. People throughout the country were amazed at the daring of the two railroad companies in establishing a schedule requiring an average of between 45 and 50 miles an hour for nearly 1000 miles. Many thought the venture would fail since the cost of keeping the property in first class order would be excessive. Some predicted that the trains soon would be withdrawn.

With the exception of a few months in 1905, when the schedule was boosted to permit the runs to be made in 18 hours, these trains each have made more than 9000 trips between the two cities on the 20-hour schedule. Today they have become nationally and internationally known as examples of the best that American railroads have to offer in the way of speed, comfort and safety to the traveler. The business man may transact his business in New York in the morning, catch the train at lunch time, and at ten o'clock the next morning be in his office in Chicago.

Newspapers, in reporting the start of the silver anniversary runs, laid great stress upon the spick and span condition of the trains as they pulled out of their respective terminals. Contrasts were made between the relatively small engines which pulled the first trains on the epochal runs and the steel monsters of today. The coaches on the first trains were compared with the modern Pullmans, which provide every comfort for the traveler. Even the train crews, who guide the trains through the day and the night, in winter and in summer, in good weather and in bad, received a share in the glory of the occasion.

However, one factor which is responsible in a large measure for safety in railroad travel, failed to receive consideration. Mention was not made of the hundreds of miles of track over

which the trains travel so swiftly and smoothly. Rails, ties, frogs, switches, fastenings, spikes and other miscellaneous equipment have been combined into a roadway capable of withstanding the severe pounding of heavy trains thundering on at high speeds. Progress in the manufacture of track equipment undoubtedly has kept pace with the development in motive power and rolling stock which make up the luxurious trains on any of the trunk line railroads of today.

Considerable change has taken place in types of frogs and switches used during the past 25 years. Increases in the weight of rolling stock have necessitated the use of much heavier rails, and likewise heavier frogs, switches, guard rails and crossings. Manganese steel now is used extensively in the manufacture of the cast track equipment, demanding radical changes and improvements both in physical and chemical properties. Changes in specifications naturally have multiplied the problems confronting the foundrymen manufacturing railroad track equipment. Great care is required in the preparation of molds into which manganese steel is to be poured, in melting the metal and in heat treating the castings after they are taken from the sand. Greater weight also increases the molding and handling problems.

An interesting example of the adaptation of modern foundry equipment to the problem of manufacturing guard rails, frogs, switches and other track equipment from manganese steel is found at the plant of the Pettibone Mulliken Co., Chicago. A description of the entire foundry of that company appeared in THE FOUNDRY for Feb. 15, 1925, on page 140 and a discussion of the methods followed by that company in merchandising its product also was published in the April 1, 1925 issue on page 261.

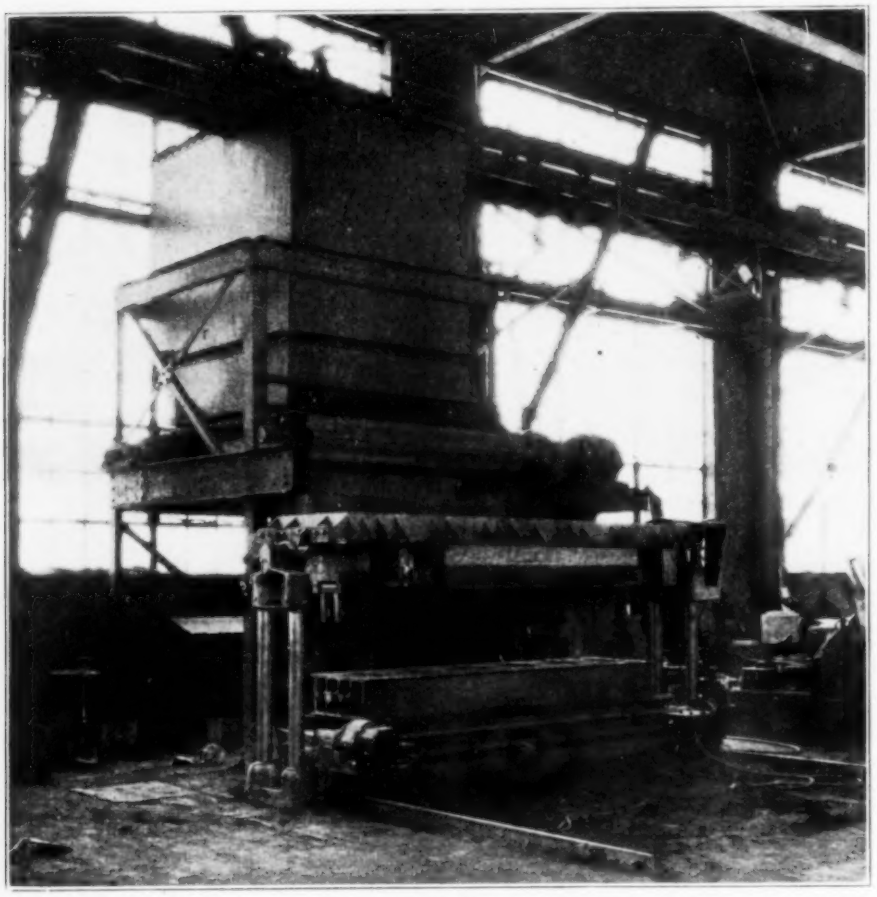


FIG. 2—POSITION OF THE MACHINE IMMEDIATELY AFTER THE PATTERN IS DRAWN

Practically every operation in the casting of guard rails, frogs and switches at the Pettibone Mulliken plant today is performed mechanically. Sand is carried from the shakeout to the mixer and from the mixer to the molding station on conveyors. The molds are made on a large machine and are carried from the machine to the pouring floor by a special crane. Since frogs were being molded at the time the unit was inspected, this description will be confined to the various steps in making that particular type of track equipment.

Molds are made on a large jolt, rollover, pattern-draw molding machine, which was manufactured by the Osborn Mfg. Co., Cleveland, and installed in the spring of 1926. Several views of the machine in various stages of operation are shown in Figs. 1, 2 and 3. In making frogs the machine handles a flask having a width of 30 inches and a length of 12 feet, both dimensions being taken on the inside of the flask. Approximately 25 frog molds or 75 drags for guard rails are made on this machine in a 9-hour day. The copes for the guard rails are made on the floor. The machine also is used for other large commercial work made at the plant, such as liner plates weighing from 600 up to 2000 pounds. Production depends upon the class of work being molded.

Patterns are mounted on a rectangular follow board which is bolted to the rollover table of the machine. Patterns for both the cope and drag of the various types of frogs to be made, are stored a short distance to one side of the machine. One of the overhead cranes, which serves the bay in which the machine is located, is used to shift the patterns from the storage pile to the machine and back to the storage. Flasks used in this work are piled to one side of the machine, and are placed on the machine either by the overhead crane or by a monorail hoist built by the Ingersoll-Rand Co., New York.

Clean Pattern Carefully

After the drag pattern and follow board have been fastened securely to the rollover table, the pattern is cleaned carefully with compressed air and a brush. Since the design of frogs varies considerably, loose pieces often are necessary to permit a draw. When loose pieces form a part of the pattern, they are cleaned carefully and placed in position on the pattern. The Pettibone Mulliken company also has found it advisable to use chills on one or two points on the casting, and when chills are to be used, they next are placed in position on the pattern.

The entire pattern is covered with a specially prepared facing sand. The facing sand is mixed in a battery of muller type sand mixing machines made by the National Engineering Co., Chicago, and located at the west end of the long bay. The sand, after being prepared, is placed in special boxes, which may be seen on either side of the molding machine shown in Fig. 1. The boxes have 4 rings located at the top, so that they may be handled easily by the overhead crane from the mixing machines to the molding floor.

As soon as the pattern has been

covered with the facing sand, the flask is placed in position on the follow board by the crane or the monorail hoist. The flask is held in place by 8 lugs, 4 on a side, which are bolted through the follow board to the cast steel rollover table. A special feature of the flask equipment is the use of a special bottom plate instead of the usual bottom board. This plate is made in three sections which are bolted securely to the bottom of the drag flask, as may be noted in Fig. 1. Each section of the bottom plate consists of a frame and 6 triangular shaped bars extending across the width of the flask. This type of bottom plate has given excellent results and greatly facilitates the ease with which the flasks may be handled from the molding machine.

Before describing the operation of the machine in molding, it may be of interest to consider briefly the method of preparing molding sand in this plant. All sand is prepared in a special department located in the west end of the north bay. Sand is carried on a conveyor from the shakeout platform to a rotary breaker, which breaks up the sand lumps and cores.

Use Magnetic Separator

A magnetic separator removes ferrous material from the sand and a screen takes out other foreign materials and remaining lumps. The sand that falls through the perforations in the breaker, passes under another magnetic separator and then is elevated and discharged on a revolving screen. The sand then falls on a reciprocating flight conveyor where clay and water are added as required. It then is discharged upon a conveyor belt which carries it to the molding stations. The complete sand preparing equipment was installed by the Link-Belt Co., Chicago.

The sand is carried to the large jolt, rollover machine on the conveyor shown in the background, Fig. 1, and is discharged into the large storage bin located immediately above the molding machine and also shown in the illustration. The sand is deflected from the conveyor to the bin by a plow, which is operated by a man stationed on the runway above the conveyor. The plow is shown in Fig. 1 immediately above the large sand storage bin.

The bottom of the storage bin consists of an apron conveyor, as may be noted in Figs. 2 and 3. This steel conveyor belt revolves on rollers located at each end of the bin and is driven by an electric motor through a reduction gear, which is shown at the right of the storage bin in Fig. 1. When the flask has been prepared to receive the sand, the chute, located in front of the bin, is moved out so that the sand will drop into the desired position in the flask. When the chute is moved out, the guard over the front roller, shown in Fig. 1, also is moved up automatically. The guard closes when the chute is returned to the position shown in Fig. 1, thus preventing any sand from falling on the workmen around the molding machine table.

With the chute in position over the flask, the motor is started by the operator and sand from the storage bin is carried to the chute and falls into the flask. After the correct amount of sand has dropped into the flask, the motor is stopped and the chute swung back into the position shown in Fig. 1. The mold then is rammed by jolting.

The large jolt, rollover, pattern-draw, molding machine has a jolting capacity of 12,000 pounds, with a jolting cylinder 24 inches in diameter. The overall length of the machine is 156 inches and the flask space, or the maximum total height of the flask, pattern plate and bottom board is 24 inches. The width of the rollover table is 48 inches, while the machine has a pattern draw of 22 inches. The jolting mechanism and the vibrator are operated by compressed air, while the remainder of the operations performed by the machine are accomplished by electrical equipment. Power for the rollover and the pattern draw operations is supplied by an electric motor located in the pit, at the base of the machine.

After jolting, the mold is butted off by two operators using pneumatic rammers manufactured by George Oldham & Sons Co., Baltimore. The mold then is rolled over and is held in the raised position while the run out car is moved to position under the mold. This car is driven by an electric motor, which is shown mounted on one side in Figs. 2 and 3. The motor is controlled by the operator at his station on one side of the machine and previously described. The car is equipped with a steel bar on the edge nearest to the molding machine which strikes off the sand on the jolt table as the car moves into position under the mold. A brush, located immediately in rear of the strike off bar completes the cleaning of the jolt table.

A special leveling device is provided for the run out car which compensates for inaccuracies in the flask equipment and permits the molding ma-

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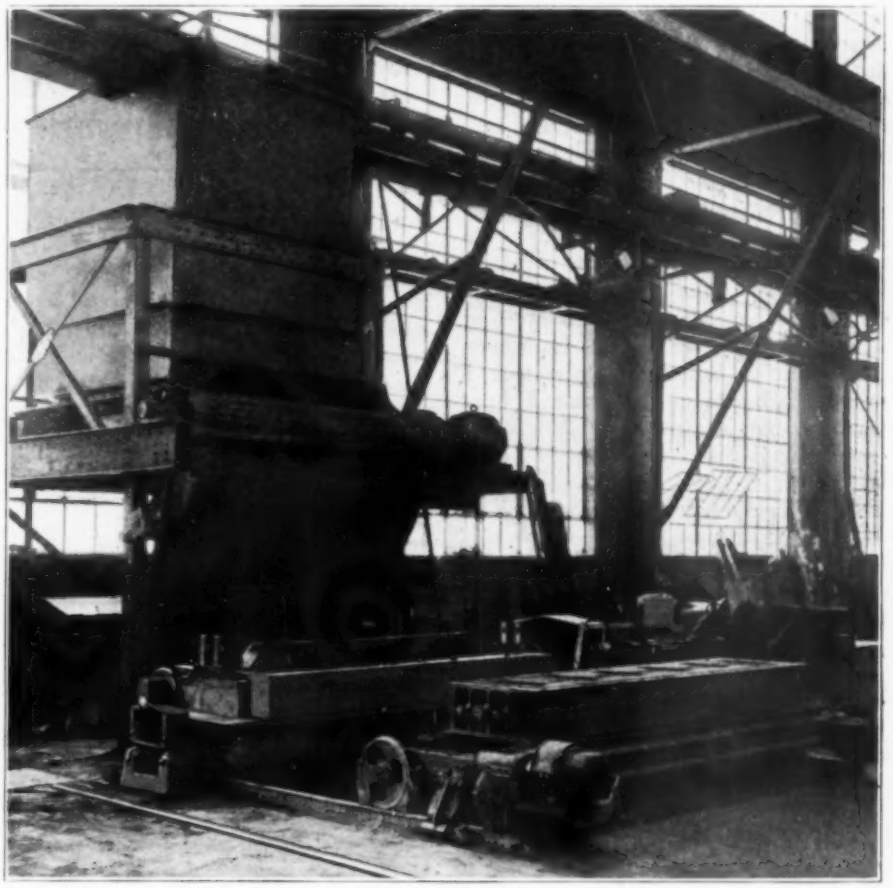


FIG. 3—MOLD CARRIED OUT ON RUN OUT CAR AND PATTERN AGAIN ROLLED OVER

Performs Sliding Abrasion Test

Brinell Hardness and Chemical Composition Have no Relation to Abrasion Resistance—Increase of Pearlite in Structure Increases Resisting Power

IN MANY instances cast iron is subjected to abrasion in the form of rubbing or sliding friction. To determine the characteristics of cast iron best adapted to this type of abrasion, Otto H. Lehman, in *Giesserei-Zeitung*, Nov. 1, Nov. 15 and Dec. 1, 1926, performed a number of tests and the results of his tests and conclusions are interesting. The material used for the tests mainly taken from brake shoes and subjected to a rubbing action on the machine shown in Fig. 1. The test pieces were 1.18 x 0.985 x 0.79 inches and pressed by weights against the revolving disk of the machine. This disk was 4¾ inches in diameter and 1 3/16 inches wide and revolved at 400 revolutions per minute. The disk was composed of wheel tire steel in some cases and cast iron in others. One disk of soft cast iron had a brinell hardness of 152, and a hard cast iron disk a hardness of 203. These values were the mean of 8 compressions.

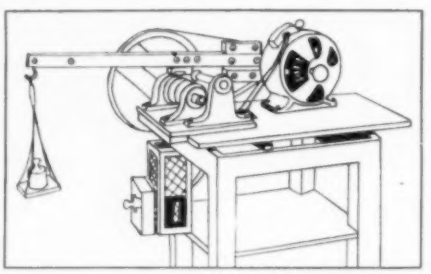
After preliminary tests with pressures of 11, 22, 44, 66 and 88 pounds, a pressure of 22 pounds was chosen for the standard pressure. In Table I the results from 11 specimens are given. In the beginning of the test, the specimens made a line contact with the disk. Due to abrasion, this line later formed a cylindrical surface. Table I shows that the abrasion, in general, decreases with increase of brinell hardness.

Test pieces with a large amount of silicon show a low temperature compared to other pieces and have a high abrasion. Although the brinell hardness is high, abrasion is comparatively large. Discoloring of test pieces near the rubbing surface indicates that the temperatures are considerably higher than the thermometer shows, and the higher the temperatures, the greater the resistance to abrasion. Apparently in the soft test pieces, the graphite acts as a lubricant and causes a smaller temperature rise.

Draws Conclusions

SOME recent investigations were carried out in Germany to determine the effect of sliding or rubbing abrasion on cast iron. This article which is abstracted from the German by R. S. MacPherran, Allis-Chalmers Co., West Allis, Wis., presents the results obtained and the conclusions derived from the tests performed.

Abrasion increases rapidly when the hardness is below 160. If the silicon is higher, abrasion is larger in spite of greater brinell hardness. In some tests performed later, the shape of the test piece was changed to a *T*-form with the foot of the *T* resting against the disk. With the new form of piece a pressure of 114 pounds per square inch was maintained and the piece was ground through for each test. The disk as well as the test piece were cleaned with alcohol to remove any lubricating influence.



SKETCH OF ABRASION TESTING MACHINE

The first main test with the new form of test piece was performed with pieces of brake shoe cast iron from 123 to 185 brinell hardness against a friction disk of rail steel. The pressure was 114 pounds per square inch; the running time 2 hours and the disk revolved 400 revolutions per minute. Table II gives the abrasion results, chemical analyses and hardness of the test pieces, and Table III shows the structural composition of the various pieces used in the test.

Samples with a hardness below 130 have an extremely high abrasion. Specimens 15C and 16C lasted only one hour and 17C showed a high abrasion at first and stopped suddenly after 30 minutes run. The temperature of the disk was 100 to 120 degrees Cent. and the disk was covered with a black coating where the test piece ran. This black coat was graphite which acted as a lubricant. Preliminary tests showed that the abrasion resistance decreases with an increase in silicon. The tests also shows that resistance against abrasion cannot be judged by brinell hardness.

Another test was performed using test pieces of brake shoe cast iron, cylinder cast iron and piston bushing cast iron against a disk of chilled cast iron. The pressure, time and speed of the disk remained the same as in the previous test. Glazing of cast iron surfaces such as cylinders and piston rings is explained by a surface break-down due to friction at the beginning of the running period. The surface is covered by small particles torn off primarily from the surface of the softer piece. These particles later fill the pores and lower portions of both surfaces and it is possible to remove these shining sur-

Table 1

Gives Chemical Composition and Other Data

No.	Brinell	Loss in grams	Chemical Composition Si	Gr.	P	S	Temp. degrees C.	Color
5A	127	2.91	2.30	2.70	0.60	0.08	80-96	None
7A	181	1.35	1.70	1.90	0.77	0.13	80-97	dark yellow
11A	182	1.42	1.07	1.79	0.25	0.20	80-97	yellow
2A	183	0.98	2.13	1.80	0.79	0.17	83-98	yellow—dark blue
8A	185	1.76	2.24	1.73	0.98	0.13	80-96	dark yellow
3A	212	1.16	2.08	1.39	0.80	0.20	96-100	dark yellow—blue
6A	217	1.16	1.57	1.49	0.75	0.25	93-100	blue
4A	218	2.00	2.59	1.45	0.80	0.20	81-94	yellow—faint blue
10A	224	1.17	1.60	1.50	0.40	4.37	not taken	yellow—faint blue
9A	226	1.20	1.49	1.25	0.78	0.26	not taken	yellow—dark blue
1A	257	0.90	1.05	0.79	0.77	0.27	not taken	yellow—dark blue

faces in the form of scale. Surfaces of cylinders show better wearing qualities if they are ground instead of turned as the pressure of cutting tools produces small cracks in the surface which are detrimental to its wearing qualities.

Data obtained from all the tests may be summarized as follows:

Brinell hardness does not indicate the quality against frictional resistance.

Chemical composition cannot be used as a guide for judging abrasion qualities.

The rubbing and rubbed parts are being covered by graphite and both surfaces resist abrasion due to lubricating action of graphite.

Resistance against abrasion is increased with increasing pearlite content without noticeable influence of the phosphide eutectic.

If the parts rubbing against each other have a pure pearlite structure, abrasion is least.

A further test using test specimens of brake shoe cast iron against a disk of soft cast iron with a brinell hardness of 152 was carried out. The conditions of pressure, time and speed of the disk were the same as the other tests. Table IV gives the structures of the graphite needles, the structural composition, and the wear of the specimens tested. From the tests the following conclusions may be drawn:

No relations exist between abrasion and brinell hardness.

No relations exist between chemical composition and abrasion.

Rubbing as well as rubbed parts contribute to the graphite coating.

Resistance against abrasion increases with increase of pearlite in the structure, but is unfavorably influenced by the grinding action of small particles torn out form the softer surface of the test disk.

Resume of Various Tests

Cast Iron on Steel

Brinell hardness has no bearing on the abrasion. Chemical composition has no bearing on abrasion. Machining quality of the iron has no relation to abrasion resistance. Graphite separation and its quantity have no noticeable bearing on abrasion resistance. Resistance against abrasion increases with increasing pearlite in the structure and is influenced unfavorably by the presence of phosphide eutectic. Gray cast iron with full pearlitic structure has the minimum abrasion.

Cast Iron on Steel

Brinell hardness and chemical composition same as in cast iron on steel. The friction disk and test piece contribute to the graphite coating which reduces abrasion. Resistance against abrasion increases with increasing pearlitic structure without unfavorable influence of phosphide eutectoid. Full pearlitic structure has minimum abrasion.

Cast Iron on Soft Cast Iron

Brinell hardness, chemical composition, and graphite coating same as in cast iron on soft cast iron. Increasing pearlitic structure increases resistance to abrasion but grinding action of small particles torn out of softer friction disk increase abrasion.

Table II

Results Arranged by Brinell Tests

No.	Chemical Composition T. C.	Gr.	Mn	Si	P	S	Loss in grams	Brinell
17c	3.01	2.48	0.44	2.65	0.78	0.24	3.82	123
15c	2.97	2.80	0.43	2.45	0.88	0.18	29.80	126
16c	2.97	2.80	0.43	2.45	0.87	0.18	36.10	129
20c	2.94	2.90	0.44	2.57	0.73	0.20	1.12	131
18c	3.01	2.48	0.44	2.66	0.78	0.24	0.54	135
21c	2.83	2.59	0.45	2.55	0.97	0.22	0.84	143
19c	2.94	2.90	0.44	2.57	0.72	0.20	0.80	144
26c	2.89	2.27	0.46	2.48	0.95	0.17	0.51	161
24c	2.96	2.56	0.44	2.36	0.92	0.13	0.52	164
28c	2.76	1.98	1.04	0.86	0.41	0.28	1.15	168
25c	2.90	2.28	0.44	2.49	0.95	0.17	0.42	171
27c	2.76	1.98	1.04	0.86	0.41	0.28	1.17	173
22c	2.81	2.58	0.46	2.55	0.97	0.22	0.63	174
23c	2.96	2.56	0.44	2.36	0.92	0.13	0.43	185

Hard To Dry Hand Ladles

Question: We line our hand ladles with a mixture of fire clay and sharp sand and although they apparently are dry before they are used, the first iron boils and has to be pigged. With a large number of ladles in use this entails quite a loss and we will appreciate any information you can give us on how to dry the ladles thoroughly to obviate the boiling feature.

Answer: Your trouble is one that is almost universal in the foundry industry and one that apparently attracts little attention. It is recognized as one of the little leaks and the average person usually is too much interested in the major troubles that infest the foundry, to bother with the small ones. Even with a foundry employing 50 men using hand ladles the total amount of iron required to dry the ladles may not exceed 500 pounds. The only loss on this iron is the cost of melting. The iron itself later is returned to the charging floor. The net cost of drying the ladles is only about $2 and we doubt if they could be dried as satisfactorily by any other fuel at less cost.

The type of home made cast iron hand ladle usually found in the foundry is a survival of a prehistoric model and is opposed to all common sense principles. The molder knows that the steam must escape before the molten iron will lie quietly and yet he persists in daubing the wet lining material against the face of an air-tight container. The ladle may be subjected to a high heat, but a little moisture is almost sure to remain between the clay and the iron. The obvious remedy is to provide vent holes in the ladle for the steam to escape, or, follow the usual practice in some shops of heating the ladle red hot in a coal or coke fire.

Table III

Structural Composition

No.	Ferrite Per Cent	Pearlite Per Cent	Wear Grams
15c, 16c	Almost Pure	.....	29.8, 36.1
17c	About 95	About 3	3.82
20c	About 75	About 20	1.12
19c, 21c	About 60	About 30	0.80, 0.84
22c	About 50	About 40	0.63
28c, 27c	About 25	About 60	1.15, 1.17
18c, 26c, 24c	About 10	About 75	0.54, 0.51, 0.52
25c, 23c	About 5	About 90	0.42, 0.43

Table IV

Appearance of Graphite

No.	Ferrite per cent	Pearlite per cent	Graphite structure	Wear grams
15E, 16E	Almost Pure	.....	thick coarse needles	0.55, 0.42
17E, 18E	About 95	About 3	fine needles	0.39, 0.44
19E, 20E	About 75	About 20	medium coarse needles	0.35, 0.36
21E, 22E	About 60	About 30	long thin needles	0.26, 0.33
24E	About 50	About 40	medium heavy needles	0.21
26E	About 25	About 60	little medium heavy needles	0.19
25E	About 10	About 75	medium heavy needles	0.17
23E, 27E	About 5	About 90	medium heavy needles	0.17, 0.18

Specializes in A
Eighty Y

FIG. 1—OBSOLETE TYPE OF GRINDING EQUIPMENT DRIVEN BY WATER POWER. NOW MAINTAINED AS CURIOSITY

EVER since Tubal Cain fashioned the first hand flung spears, ever since the inauguration of the first modest *Buy-Something-Made-of Copper* week, manipulation of metal in practically all its forms has been regarded as a masculine prerogative, a man's job. As a rule the work is hot, heavy, hard and hazardous, calling for a high degree of skill, manual dexterity and muscular development. According to a popular tradition a blacksmith shop is no place for either a lady or a minister's son.

The same popular tradition invests the blacksmith with a halo of romance, shared by those who work at no other trade with the possible exception of soldiers and old time smugglers. Reasonable doubt may exist as to whether soldiers and smugglers should be classed as tradesmen. In the event that the claim is not upheld, the blacksmith retains all the glory for himself. Halo of romance encircling the sweat bedewed brow of the honest blacksmith had a beginning in the so-called age of chivalry when on many an occasion a long stout, whistling blade of old Toledo was all that stood between a man and a sudden and violent death.

Poets began where the old chroniclers left off and have been hanging figurative garlands on the brow of the modern descendant of Vulcan, now indeed engaged in the prosaic arts of peace. He has been assigned all the manly attributes, strength, courage, fortitude, constancy and has been credited with all the virtues including a rare and sterling honesty which enables him to look the whole world in the face.

Chroniclers and poets share a natural gift in their ability to set down thoughts in pleasing form, but so far as accuracy of statement is concerned, they show at times a careless indifference. Millions of people have read the line about the village smith who swings his heavy sledge with measured beat and slow and yet not one of these people ever saw a smith swinging a sledge with measured beat and slow—or in any other manner. The smith wields a hand hammer. Any sledging that has to be

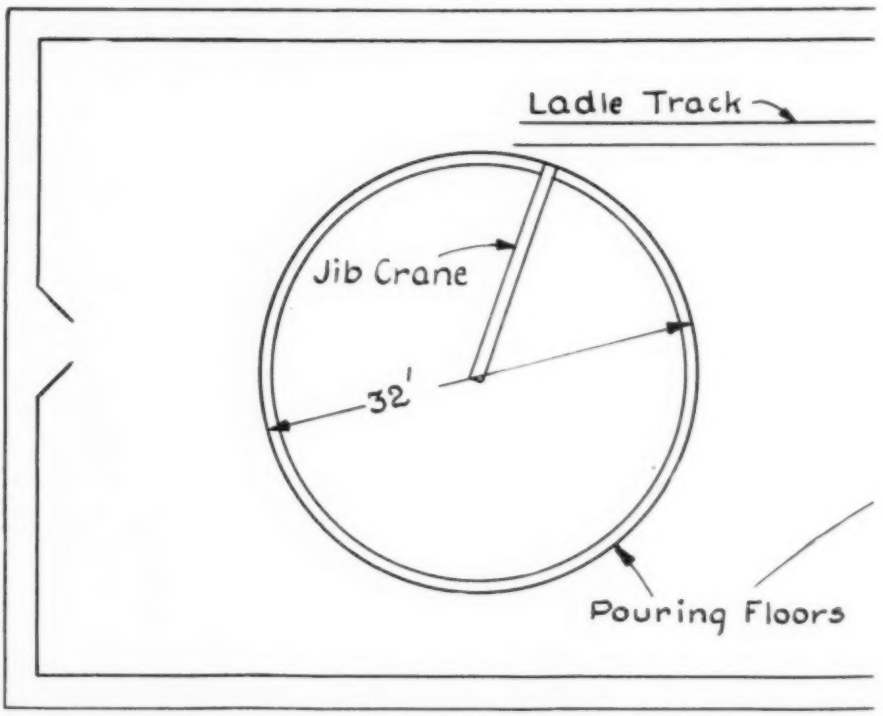


FIG. 2—OUTLINE SKETCH OF FOUNDRY FLOOR SHOWING RELATIVE POSI

Anvils for Years

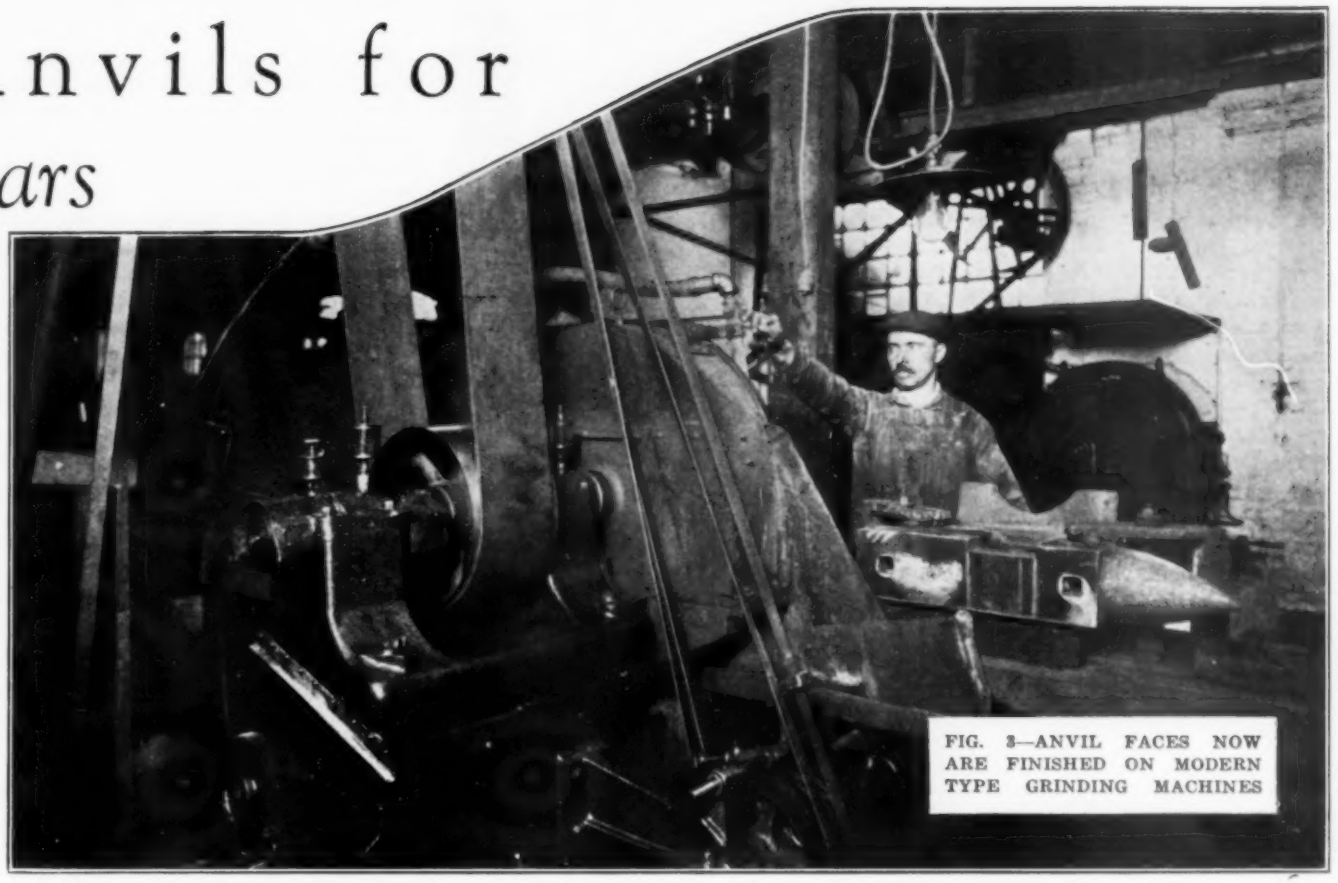
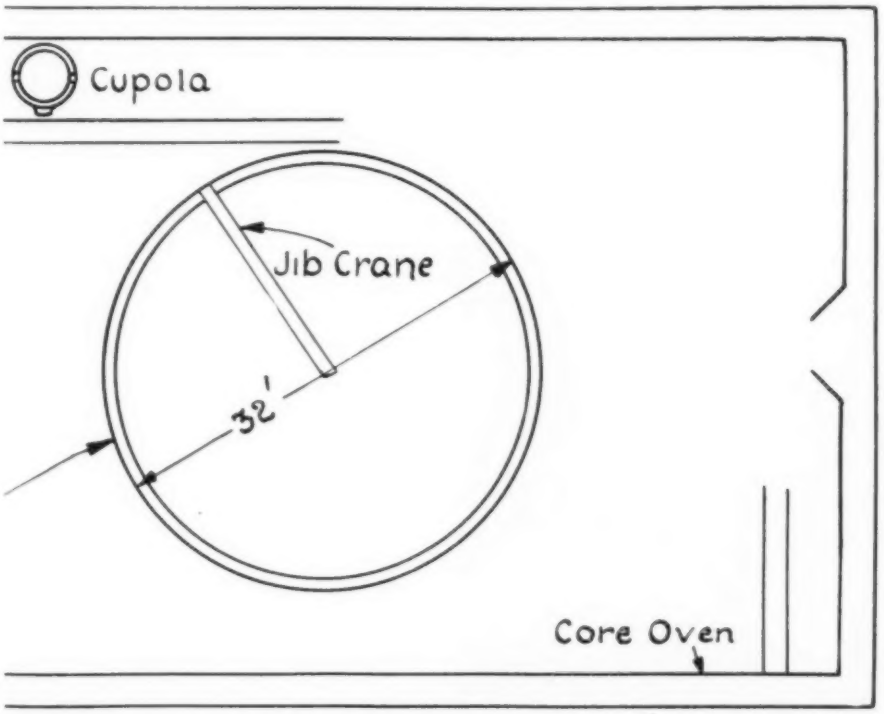


FIG. 3—ANVIL FACES NOW ARE FINISHED ON MODERN TYPE GRINDING MACHINES

done is done by his assistant, technically known as a *striker*, or, it is done under a power hammer. A smith needs at least one hand to grip the tongs holding the horse shoe or other object. A 16-pound sledge with a handle 30 inches in length is a little beyond the one-hand capacity of the village smith even if the muscles of his brawny arms are strong as iron bands referred to by the poet.

Possibly the same general carelessness is responsible for the fact that so little is known regarding the methods and equipment used in blacksmith shops. Every person knows that a smith uses a hammer to forge the pieces of iron or steel on an anvil, but how many people know that anvils are a product of the foundry. Even among foundrymen, how many know how the steel plate is welded to the face?

Answers to these and many other questions, also explanation of the shaky foundation which supports many popular traditions are found in the plant of the Fisher & Norris Eagle Anvil Works, Trenton, N. J. The first tradition to go by the board is the one claiming that a blacksmith shop is no place for a lady. Here is a plant that has been in continuous operation for over 80 years specializing in the manufacture of anvils and for the greater part of the past 25 years it has been managed by Harriet Fisher-Andrew who bravely assumed charge when the owner, her first husband Carl Fisher, died in 1902.



TION OF CUPOLA, CRANES AND MOLDING FLOORS. NOT DRAWN TO SCALE

Retains Interest

The plant includes a foundry, machine shop, forge and grinding shop and there is not an operation in any one of them on which she is not competent to issue instructions or a machine or piece of equipment which she has not handled personally at one time or another. During the past few years she has delegated practically all managerial activities to S. E. Andrew, her present husband, but she still retains the most lively interest in the operation of the establishment.

What is claimed to have been the first anvil made in America was cast

by Mark Fisher in a small plant which he built in Trenton in 1843. Up to that time these necessary adjuncts to the blacksmith shops had been imported from Europe. Trenton presented many advantages from a manufacturing standpoint. It was located at the head of tidewater on the Delaware river and on the main highway between Philadelphia and New York. Most of the manufacturing industries were located along the Atlantic seaboard. Pig iron and hard coal were available locally and a fair market either was in existence or was ready for cultivation. Some time later the Delaware and Raritan canal formed a continuous water way from the Delaware river to New York bay and helped to move an additional volume of traffic between the large centers of population in Pennsylvania and New York. This same canal also supplied power for many of the industrial establishments in the vicinity. The old flume and gates and the wheel that served as a prime mover in the Fisher-Norris Works for many years still are in existence but have not been utilized since the plant was motorized many years ago.

Naval Traditions

Mark Fisher, founder of the business was a mechanical genius and incorporated many clever ideas in building the plant and in equipping it with special machinery. His son Carl who succeeded him, inherited the inventive mind and love for mechanics which characterized his father. As an engineering officer he served for many years in the United States navy and was prominently identified with Rodman and Dahlgren in their experiments with and development of heavy ordnance. Death of his father caused him to resign his commission and take up the active management of the plant.

He designed special flasks for making the anvil castings and developed a method for attaching steel faces to the cast iron blocks. He was a

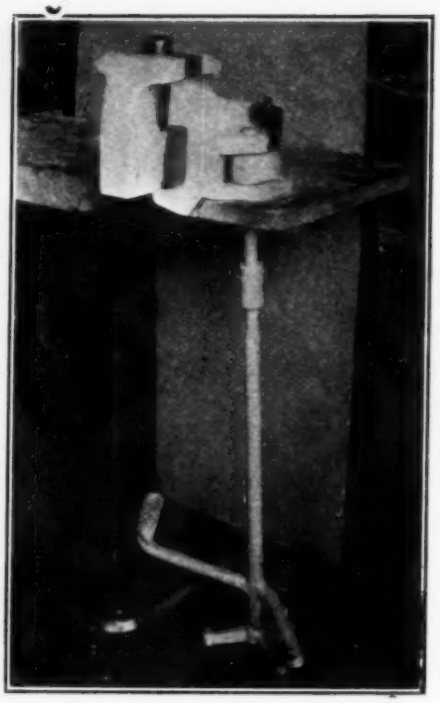


FIG. 4—FOOT CONTROLLED QUICK ACTING VISE WITH STEEL FACED JAWS

pioneer in the grinding field and was finishing the faces of the anvils by this method long before the mechanical world turned its face toward machine grinding. It is claimed that the swing grinder shown in Fig. 6 and in use for approximately 40 years antedates any other type of swing grinder in use. It was not patented by the inventor and probably served as the inspiration for other pieces of equipment that have been developed along the same or somewhat similar lines in later years. The suspension members and yoke present a crude appearance when compared with a modern swing grinder, but the device works in a perfectly satisfactory manner. In the final show down that is the only important factor to be considered in drawing comparisons.

By a curious coincidence S. E. Andrew, the present manager of the plant also has had a naval training. For several years he was an engineering officer in the Argentine navy and was a member of the inspection commission sent north by that government and domiciled in the United States during the building of two battleships for the Argentine republic, the RIVADAVIA at the Fore River plant of the Bethlehem Steel Corp., Quincy, Mass., and the MORENA at the plant of the New York Shipbuilding Co., Camden, N. J., in 1913 and 1914.

The foundry with its accompanying stockyard, pattern storage and sand sheds is located across the street from the remaining group of buildings comprising the plant. Buildings in the main group all adjoin each other. Manufacturing activities are carried on, both on the ground floor and on the second floor. A semi-basement fitted with grinding equipment shown in Fig. 1 has not been used since more modern grinding equipment was installed. The entire outfit presents an interestng example of how the work was done in an earlier day.

Stout Oak Beams

Substantial stone walls and stout oak beams in the foundry building, apparently in as good a condition as when they were set in place, reflect to some extent the sterling and rugged characteristics of the founder. Also in their contrast to modern trends and materials used in buildings of a like character, they direct attention to the age of the establishment. At periodic intervals the walls and beams are cleaned and white washed with the result that so far as surface appearance is concerned the shop might have been commissioned for the first time yesterday. Each beam is hand hewn, in one piece and over 50 feet long.

General layout of the foundry is shown in the free hand sketch Fig. 2 which is not drawn to scale. A series of cast iron plates is laid flat on the floor to form a ring approximately 32 feet diameter around each of the two jib cranes with which the foundry is equipped. The molds are placed on these rings with the runners on the outer ends and thus in a position to be poured from the crane

FIG. 5—ANVIL MOLDS ARE MADE FROM SPLIT PATTERNS IN THREE PART FLASKS WITH OPENINGS IN THE END FOR ADMISSION OF PRELIMINARY HEATING IRON AND FOR AN OVERFLOW

ladle without wasting any time running the rack in and out.

The jib of the crane is not long enough to pick up a ladle directly in

front of the cupola. The ladle is mounted on a truck and the truck in turn is pushed along a track either to the right or left until the ladle comes under the end of the jib of either of the cranes. The arrangement is the essence of simplicity and like practically all simple arrangements it fulfills the purpose for which it was intended in a highly satisfactory manner. The primary reason for pouring the iron directly from the crane ladle into the molds is that it must be poured at a high temperature to insure a union with the steel plates in the molds. Manifestly each time iron is transferred from one ladle to another the temperature is bound to drop an appreciable extent. With the arrangement just described the temperature of the iron entering the mold almost is as high as it was leaving the cupola, 2500 to 2600 degrees, Fahr. The method has many advantages. For example a comparatively heavy heat, 15 to 20 tons may be handled by a small crew without undue fatigue.

Core Oven Car

Anvil castings up to 500 pounds are made in green sand molds. Above that weight the molds are skin dried. A highly refractory sand is employed to insure a clean skin on castings that both by their thickness and the high temperatures at which they are poured, are inclined to fuse the sand on the face of the mold.

The only dry sand cores employed are those designed to form the usual hardie and bolt holes. They are made by hand on a bench behind the core oven car shown in Fig. 7. This car is almost as old as the foundry and is provided with hooks on which the ladles are suspended. The cores are placed on a flat iron plate which forms the top of the car and also which forms the connecting link between the two upright members on each side which rest on the outer ends of the axles of the four wheels.

Operating under normal conditions, anvils of various sizes are molded on the ring shown to the lower left in Fig. 9. Miscellaneous castings, principally saw anvils and vise parts are molded on the second ring partly shown in Fig. 7. This arrangement is only a matter of convenience. Under stress of special conditions the same class of castings may be made on both rings.

FIG. 7—CORE RACK, CORE BENCH AND CORE OVEN CAR ARE LOCATED AT THE OPPOSITE END OF THE FOUNDRY FROM THAT SHOWN IN FIG. 5

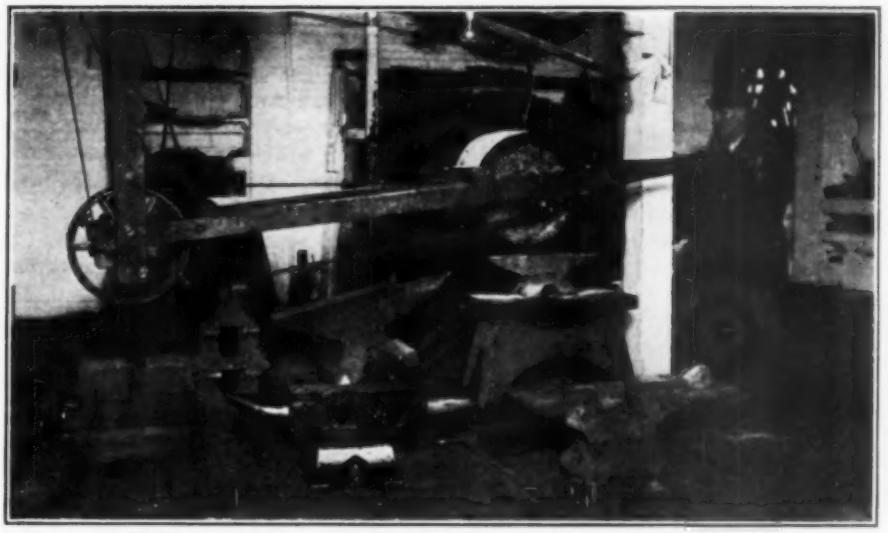


FIG. 6—ONE OF THE FIRST IF NOT ACTUALLY THE FIRST SWING GRINDER EVER BUILT STILL IS IN USE FOR GRINDING THE FACE OF MANY OF THE SMALLER ANVILS

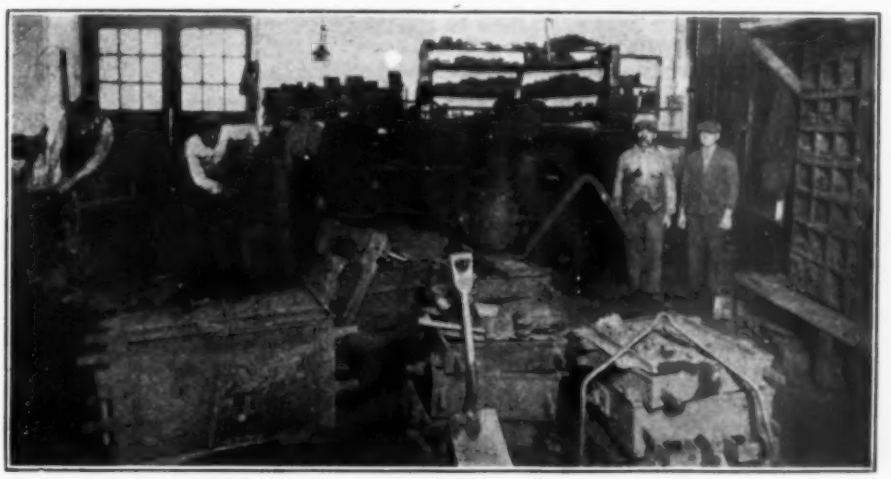
No foreign scrap is added to the pig iron mixtures from which the anvil castings are poured. On account of the metal employed for preheating the plates, also the metal in the gates and large feeding heads, the return scrap amounts to between 10 and 15 per cent. This is added to the mixture each day. The manufacturer claims that the long life claimed for the anvils is due to the fact that they are poured from an almost exclusively pig iron mixture. It is stated that an anvil poured from a scrap iron mixture will sag in the center in a comparatively short time under constant use.

Iron charges in the proportion of 1000 pounds of iron to 150 pounds of coke are melted in a cupola lined to 48 inches. Preference is shown for a hard by-product coke that holds up well under the burden and delivers the iron at a uniformly high temperature.

The manner in which one of the molding floors is laid out in a ring around one of the jib cranes is shown in Fig. 9. Sand is arranged in a circular heap on the outside of the space covered by the cast iron plates which constitute a permanent foundation on which the molds are poured. The empty flasks with the necessary auxiliary equipment are placed conveniently on the inside of the same foundation after they have been shaken out and before they are placed again in service.

Three Part Molds

The pattern for an anvil is made in two parts, joined in the center by suitable dowel pins or an adaption of a male and female joint. It is in the same class as sheave wheels and other patterns which are parted in such a manner that the two parts may be removed from the sand in opposite directions. The mold is made in a three part flask in which the drag serves principally as a preheating reservoir, the cheek contains the entire casting and the cope acts as a cover with suitable openings for the runner near one end and a feeding



head in the center of the casting.

Unless prevented by some unusual feature in construction, foundry practice favors placing the heavier part of an unequally split pattern in the bottom part of the mold. With an anvil pattern this practice practically is mandatory to facilitate a thorough union between the molten iron and the steel plate placed in the mold to form the working face of the anvil. In fact two plates are placed in the mold, one flat to cover the main working face and the other curved and pointed to enclose the horn of the anvil.

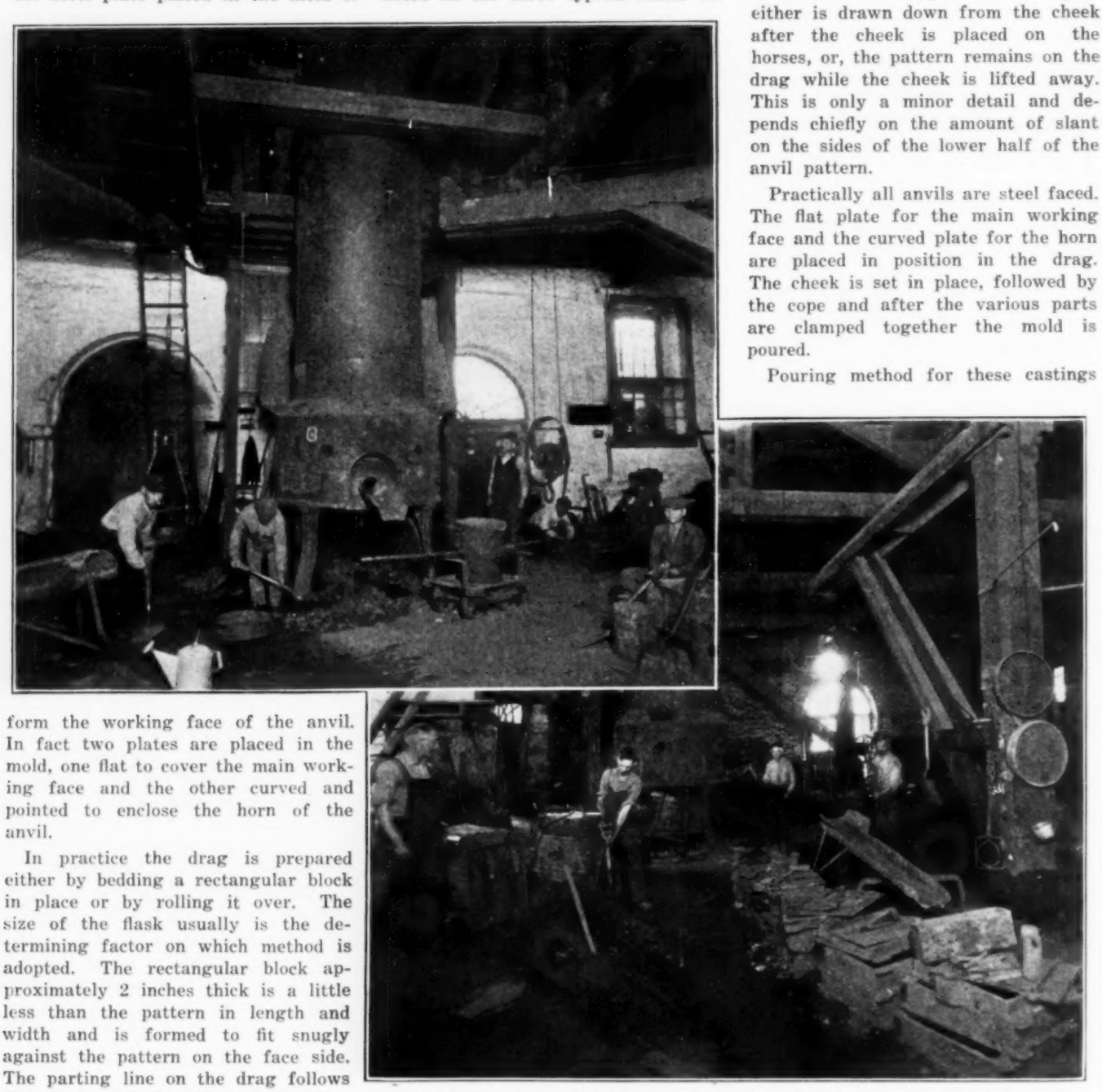
In practice the drag is prepared either by bedding a rectangular block in place or by rolling it over. The size of the flask usually is the determining factor on which method is adopted. The rectangular block approximately 2 inches thick is a little less than the pattern in length and width and is formed to fit snugly against the pattern on the face side. The parting line on the drag follows the contour of this block and consequently follows the center line on the horn of the anvil and then dips to follow the straight line indicating the main face of the casting.

After placing the entire anvil pattern on this block the cheek flask is set in position and rammed full of sand in the usual manner. Gate sticks are placed upright at each side to form a passage to the bottom of the mold for the first metal. Later additional gates are cut in the joint surface between the cheek and the cope. Usually the runner basin extending to the outer end of the flask, also the extension of the feeding head in the center, are made up before the cope is lifted from the cheek.

Several special features may be noted on the three typical flasks employed for making anvil molds and shown in Fig. 5. Each section is a one piece cast iron frame with handles and guide lugs on the ends and with trunnions on the sides of the cheek parts. One end is rectangular and the other end is pointed to conserve sand as much as possible around the horn end of the casting. The three molds are shown in position to be assembled with the drag on the floor, the cheek supported on a pair if horses and the cope at the back, turned up on edge and also resting on a pair of small wooden horses or trestles. The upper part of the pattern is drawn before the cheek is lifted from the drag. The lower part either is drawn down from the cheek after the cheek is placed on the horses, or, the pattern remains on the drag while the cheek is lifted away. This is only a minor detail and depends chiefly on the amount of slant on the sides of the lower half of the anvil pattern.

Practically all anvils are steel faced. The flat plate for the main working face and the curved plate for the horn are placed in position in the drag. The cheek is set in place, followed by the cope and after the various parts are clamped together the mold is poured.

Pouring method for these castings varies to some extent from the method employed in pouring other castings. The outside end of each cheek is provided with a small rectangular pocket connected through an opening with the inside of the flask. A runner stick is rammed in sand in this pocket to form an opening leading



FIGS. 8 AND 9—SHOW THE POSITION OF THE CUPOLA AND THE POURING LADLE ALSO THE MANNER IN WHICH THE SAND AND FLASKS ARE DISPOSED IN A CIRCLE AROUND THE CRANE

down to the cavity left by the special block in the drag.

A few minutes before the iron is poured into the mold for the anvil, a sufficient quantity is poured through the small runner in the end to fill the cavity under the steel plate. This raises the steel plate to a red heat and places it in a receptive condition for amalgamation when metal enters the mold proper shortly afterward. To insure a perfect union, a stream of metal is allowed to flow through a hole in the end of the flask, located a little distance above the bottom of the mold.

Tool Steel Plates

Naturally, the size of the overflow gate and the amount of metal poured through depend on several factors, including the size of the casting, the thickness and extent of the plates and the temperature of the iron in the ladle. The nicest degree of skill and judgment are required on the part of the operator to synchronize the various factors. Men engaged in the work develop a kind of a sixth sense, it is claimed, by which they know when the molten metal has taken a firm grip on the plate. The overflow opening in the end of the flask then is stopped with a clay plug and the remainder of the mold is filled with iron in the usual manner.

Steel plates for the anvil faces are cut from lengths of high carbon tool steel and a narrow ridge planed along each edge serves as an anchor to hold the plate in place in the mold. Average thickness of the flat plate is 1 inch. The curved plate for the horn is hammered into shape in the blacksmith shop. It is made from much thinner plate. Before the plates are placed in the mold they are sand-blasted thoroughly and coated with oil. The least oxidation on the surface will prevent the molten metal from adhering.

After the castings have been cleaned and inspected, the face is ground to a smooth true surface either on the veteran swing grinder shown in Fig. 6 or on the strictly modern grinding machine shown in Fig. 3 where the castings travel back and forth on a movable table past a fixed revolving wheel.

Makes Track Specialties with Modern Equipment

(*Concluded from Page* 721)

chine to make a straight draw. The device consists of 4 oil, dash pots located at the corners of the car. As the rollover table with the mold bolted to it is lowered to the run out car, the oil dash pots automatically adjust themselves in a position which holds the mold square with the pattern. When the pots have become adjusted, they are locked by compressed air which is controlled by the operator at his station.

Secure Clean Draw

With the mold resting on the run out car, the vibrator is started by the operator and the pattern is drawn from the mold. Although some of the patterns used on this machine are rather difficult to draw, remarkably clean molds are secured.

After the pattern has been drawn, the run out car is moved out to the position shown in Fig. 3, the pattern is rolled over, cleaned and the next mold started. Several members of the crew then place the necessary nails in the mold and set such cores as are necessary. Of course, the amount of core work depends again on the design of the casting, although the bolt holes in the frog always are cored. The cores are made in the core room located at the west end of the north bay, which also makes the cores for the remainder of the foundry. That department of the foundry is described in the description of the plant previously mentioned.

The molds are carried from the run out car to the floor by a gantry crane made by the Harnischfeger Corp., Milwaukee, and partially shown in Fig. 1. The crane is 18 feet wide and travels 100 feet from the machine to the end of the floor. The drag molds are allowed to air dry 24 hours before pouring.

After a sufficient number of drag molds have been made, the pattern is removed and the follow board and pattern for the cope are bolted to the machine. The cope is made in the same manner as the drag. The copes are taken from the machine to an oven, where they are dried before being placed on the drag half of the mold. The gate is constructed at the heavy end of the casting, and a strain gate is used at the opposite end. The gate is made from rectangular baked refractory blocks which have a cylindrical hole through the center. A special block also is used at the bottom of the gate, which rests in the drag, to prevent the cutting and washing action of the sand.

Manganese steel for the castings is melted in two 3-ton electric furnaces built by the American Bridge Co., New York. Castings are annealed in furnaces built by Pettibone Mulliken Co., Holcroft & Co., Detroit, Continental Industrial Engineers, Chicago, and the Electric Furnace Co., Salem, O. Descriptions of the melting equipment, annealing ovens and the chemical and physical laboratories are given in the previous article on the plant. Castings are cleaned and ground where necessary in the cleaning and grinding department located at some distance from the foundry. The castings are loaded in railway cars and carried to the cleaning department by an electric engine.

Specifications for Gray Iron Car Wheels

Question: Will you please let us know what is the standard analysis for the chilled iron car wheels used under railroad freight cars?

Answer: There is no such thing as a standard analysis for chilled car wheels. Every railroad company has its own specifications. However, these various specifications chemical and physical do not differ to any great extent and approximate the following: Silicon 0.60 to 0.90 per cent, sulphur 0.10 to 0.15 per cent, phosphorus 0.30 to 0.40 per cent, manganese 0.60 to 0.70 per cent.

Chemical specifications issued by one prominent railroad company in the east calls for wheels of the following analysis: Total carbon 3.35 per cent minimum, graphitic carbon 0.90 per cent maximum, sulphur 0.17 per cent maximum, phosphorus 0.35 per cent minimum. The silicon content is not specified.

For your further information the chilled cast iron car wheel is an American product. The diameter of the standard wheel is 33 inches on the tread irrespective of the weight of the wheels which are divided into four classes. These are 650-pound wheels for 60,000-pound capacity cars, 700-pound wheels for 80,000-pound capacity cars, 750-pound wheels for 100,000-pound capacity cars and 850-pound wheels for cars with a carrying capacity of 140,000 pounds. The gross weight of each type of car is much greater since it includes the *tare*, that is the weight of the car itself. For example the gross weight of a loaded car of the fourth class is 210,000 pounds. From this it is apparent that each of the eight wheels supports a load of 13 tons.

Description of car wheel founding appeared in THE FOUNDRY April 15 and Sept. 15, 1924. A comprehensive series of six articles on the subject of chilled car wheels was published in consecutive issues of THE FOUNDRY April 1 to June 15, 1920.

How and Why in Brass Founding

By Charles Vickers

Fumes Cause Discomfort

We are casting yellow brass and as the work is thin, the brass must be so hot the fumes fill the foundry at each pouring causing great discomfort to the workmen. We propound the following questions—(a) Is there any flux, except aluminum, that will positively make the metal more fluid at lower temperatures? (b) Is there any method that will hold the fumes to a minimum except leaving glass on the metal while pouring? (c) How serious are the zinc fumes on the workers over a period of time? (d) Is there any respirator the men can use and still get enough air while working? (e) Is it customary for large foundries making this kind of work to have a pouring room where fumes can be removed by suction? (f) Is there any method by which zinc fumes can be entirely eliminated from the face of the castings?

(a) There is no flux at present on the market that will answer in place of aluminum for giving fluidity at non-smoking temperatures. Aluminum has this effect because it produces a tenacious film over the metal surfaces, which it lays on the sand surfaces of the molds as the stream advances, eliminating the friction of the sand surface. Thus the aluminum-treated alloy flows easily at a non-smoking temperature. (b) No, because at a certain temperature the zinc rapidly distills from the melt and as its vapor comes into contact with the atmosphere it is oxidized to zinc oxide, and a little zinc makes a lot of fume. Glass, being tenacious makes a good covering, but it will flow into the mold with the metal and become a part of the casting. (c) Zinc fumes give rise to *spelter shakes* and if these become common with any individual he would be foolish to continue working in such a place for if long continued they would be harmful. See Bulletin 73 department of the interior, bureau of mines; page 258 onward. This bulletin may be obtained from the superintendent of documents, government printing office, Washington, price 45 cents. (d) Respirators are advertised in THE FOUNDRY, write the makers. (e) No, it is not customary, but common sense suggests this should be done, as it is easy and economical to shift the molds out of the molding room and into a pouring-off room. The pouring-off gang should be equipped with respirators, and by having a trained pouring-off gang, the saving of misrun castings would be worth while. The molders should not be exposed to cold or fumes of any kind, as they are producers and cannot work to good purpose when suffering. (f) Yes, the presence of zinc fume markings on the castings is proof the present pourers do not know how to pour yellow brass, as the trick is to fill the mold with brass and not fumes. This is done by extremely rapid pouring to keep the sprue filled all the time until it overflows. This is not necessary with aluminized brass.

Gives Mixture Formulas

Will you answer the following questions? (1) *What is a good metal mixture;* (2) *Also a good bronze mixture;* (3) *Just what does tin, zinc and phosphorus do to the mixture?*

A good metal mixture for some classes of casting is copper, 85 per cent; tin, 5 per cent; zinc, 5 per cent, and lead, 5 per cent. It is a rather expensive red brass in great favor with the technical personnel of the brass foundry industry but seldom used by the practical ones who have competition to deal with. It is, however, a good mixture. Another one, somewhat cheaper is copper, 70 per cent; zinc, 25 per cent; lead, 3 per cent; tin, 2 per cent. This is a casting yellow brass quite easy to cast for the type of alloy to those who understand casting yellow metal, but exceeding difficult to those who do not. A good bronze mixture is copper, 89.50 per cent; tin, 10 per cent, 30 per cent manganese-copper, 0.5 per cent, and this mixture is better than the 88-10-2 alloy.

Question (3);—Copper and tin alloyed make bronze, so do copper and aluminum, and also copper and silicon, but the easiest casting alloys are those with copper and tin. Copper and zinc make brass. Bronze is rather golden in color and brass is yellowish, but by combining the two we get cheaper mixtures known as red brass which resembles bronze in color. They are cheaper than the real bronzes because they contain less tin. The 85-5-5-5 mixture may be assumed to be an example of these half way alloys known as red brasses. Phosphorus modifies both types of alloys, some say it deoxidizes, also it hardens the alloy. As a deoxidizer or modifier for red brasses it must be kept low and 2 ounces of 15 per cent phosphor-copper will be sufficient for 100 pounds of such alloys. In the case of bronzes though several per cent of phosphorous may be added.

Bearings Contain Holes

We send for examination a sample of a brass axle bearing for a street car motor. We have experienced trouble, the castings developing cracks when molded by hand. We decided it was due to hard ramming of the drag as machine-molded castings of the same weight cause no trouble.

We believe that you are correct in assuming that hard ramming of the drag is responsible for the difficulty shown by the sample and we presume they are cast *bearing down.* Such castings always have been made by the author *bearing up* because when made that way, no trouble ever is experienced and production is increased. In the present case the hydrogen from the damp sand has permeated the metal in considerable quantity. Instead of exploding under the bottom board it has entered the molten metal causing the peculiar *oxidized* condition at the top of the arch, and gathering in a layer underneath, it has formed the split. When a mold is poured, many skimmers shoot the red hot piece of iron under the bottom board and there is immediate ignition, sometimes an explosion; always with large molds. This is hydrogen combining with the oxygen of the atmosphere. The condition will disappear when the drag is rammed softer. It really should be vented with a free outlet between bottom board and edge of flask. The best bottom board is a perforated plate, and the best flask a perforated one. It would solve many troubles from *oxidized* brass. For information on molding axle bearings for electric cars see an article by Charles Vickers in THE FOUNDRY, September, 1910, page 15.

Bill Is Introduced To a Prospective Foundryman

By Pat Dwyer

BILL came over the other night and suggested I should accompany him down town to visit an industrial exposition staged in the public auditorium. Mrs. Bill was with him. She proposed that my wife also should come, make up a jolly little party, take a night off, chase dull care away, see the sights and incidentally add to our store of useful knowledge and familiarize ourselves with what made the wheels of industry go around in this large and flourishing community.

The proposition appealed to me from many angles, but I think principally because it brought up memories of the old time county fairs I had attended at a period of life when one of these events was looked forward to for months with the keenest interest and anticipation and which furnished a topic of conversation for months afterward.

As a member of the *Prospect Silver Cornet Band* admission was free—a feature of some moment in these days. Between selections we had plenty of time to swagger around in our uniforms and brass buttons, the envy of all or nearly all the boys and young men and a never failing attraction for the girls. For one glorious day in the year we had the world by the tail in a down hill pull. Rambling nonchalantly hither and yon we threw a critical if somewhat unprofessional eye over the fat pigs, the cows, the horses and the big, lordly bulls peering suspiciously out of blood shot and wicked little eyes. Each bull was anchored firmly by a ring through the nose or the snout or whatever it is you call the end of a bull's face. I have known men who professed to regard these big, hulking brutes as harmless. Perhaps they are. I prefer to view them at a respectable distance chained to a stout post—steel for choice—and with a good, reliable fence between us. The prejudice may be unreasonable. I may be doing the poor, dumb brutes a rank injustice, but there it is and I can't help it.

If I were offered my choice of all the animals that roam the fields, with the birds and fishes thrown in for good measure, a bull, big or little would be the last animal I would pick for a pet. As with a famous saying in a former generation about the Indian, I think the only good bull is a dead bull—preferably barbecued.

Before the limited financial resources were exhausted we wagered small sums on the various horse races, the great drawing card every afternoon, but we were denied the thrill of watching the beautiful and high spirited animals—referred to vulgarly as beetles or goats—straining every nerve, whirling around the track like the everlasting mill tail of—Ahem! What I mean to say is that these—er—race horses proceeded around the track at a remarkably rapid pace.

Speed, of course, is a relative term. In the present day we are accustomed to automobiles doing 100 miles an hour and air ships flying at twice that speed, but in the days to which I refer a bunch of horses with tight lipped drivers hunched on the seats of high wheeled sulkies, drumming up the dust and coming down the home stretch and under the wire in 2 minutes and 20 seconds, was enough to bring a crowd of wildly cheering people to its collective feet. Particularly that part of the crowd which had placed a vote of financial confidence on the winner in advance.

Members of the band, with the exception of a few tunefully artistic and highly skilled lads who could play without notes, never saw the races. Immediately before each race the leader raised his cornet to his lips, counted one-two, one-two with his free hand and we were off to a rattling taran-ta-ra quickstep, repeated *ad lib* until the race was over and the excitement of the finish had died down.

Whatever little familiarity I may have with racing scenes has been gained at other times and in other places where I have not been forced to keep my eyes glued on a music score clipped to a wobbly stand with a clothes pin to prevent the wind from blowing it away. For the reminiscent benefit of any former bandsman who may have wasted his time in a similar manner in the easy going days of his youth, also as indicative of the period, I may say that on one of these occasions that sterling old Sousa march *Manhattan Beach* was new. We played it so often that even the bass drummer, who had

SPORT OF KINGS AND MAYBE A FEW JACKS

been elected to the position for his size rather than for any rudiment of a musical ear, finally learned to bang through it correctly. His ability to hit the drum at the wrong time was a constant thorn in the side of the leader on practice nights, but his majestic appearance on parade amply compensated for a slip of the hand now and again or an odd tap too many.

What are a few bumps on a drum one way or another among friends? Also while the big drummer calmly accepted a mild reproof occasionally from the leader, he somehow managed to convey the impression that he was not seeking any instruction or advice from the rank and file. 'Twas his drum and he was going to beat it any way be pleased. See? He was about 6½ feet high and 3 feet wide and was reputed to be quite handy with the dukes. A nice friendly boy in many ways, but about as playful in an argument as a grizzly bear or a modern traffic cop.

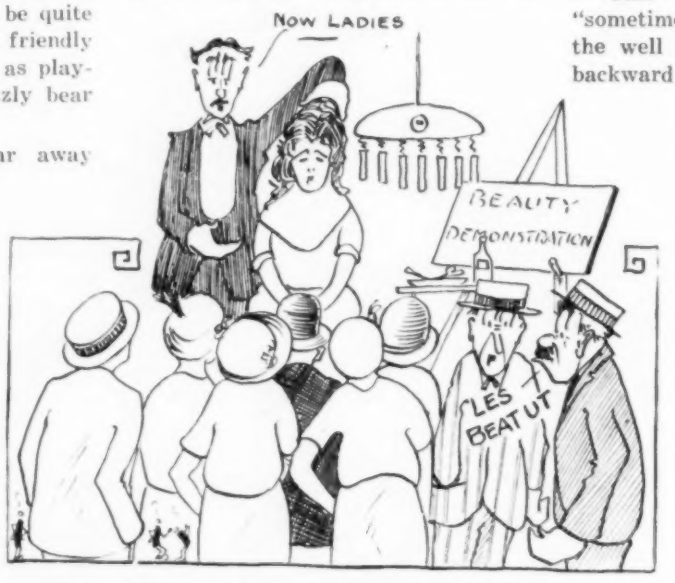
However, all that was far away and long ago. I have not played in a band for years, but I still feel a kinship with every man who handles a brazen instrument. The sight of a band swinging down the street, the blare of marching music, the snappy rattle of the snare drum and the exhilarating, booming battle roar of the big drum, lift me on the wings of ecstasy. The years flow away swiftly on memory's screen and in fancy once again I am without a care in the world, stepping gaily down the street, third row from the front, second man from the left, tootling bravely with sweat oozing into my eyes and dripping from the very lobes of my ears.

With this background I easily was persuaded to accompany Bill since one of the attractions at the exposition was the band—100 men—count 'em—100—of one Lieutenant Commander John Phillip Sousa, composer extraordinary of rousing musical numbers including the one time highly popular *Manhattan Beach*.

The visit was a success so far as listening to the band was concerned, but practically was a dead loss reckoned on a sight seeing basis. This bold statement necessarily does not mean that exhibits were lacking or unworthy of attention. On the contrary the flying peep I had at some of them convinced me that I could spend a day willingly and profitably in viewing them closely and in enjoying a few words with the men who occupied the various booths.

Bill summed the situation up wearily when he informed me out of the corner of his mouth in a guarded whisper that a man was a fool to drag a woman around with him if he expected to see anything.

If I had been in the mood, or if I had the time to start an argument I could have pointed out to him that it was the women who were doing the dragging. They saw nothing worthy of detailed attention and plowed steadily onward. We either had to let them get lost in the crowd or go with them as they paraded up and down the various aisles. At several points I was tempted strongly to let them go, but the crook of an imperious finger and an impatient "Come on, don't stand there all night, gawking," sent the temptation glimmering and kept the cozy little party together and on its way.



HEAP BIG CHIEF GIVES WAR PAINT DEMONSTRATION

Finally we arrived at a point where the aisle was jammed solidly with a crowd of people apparently intently interested on what was going on in one of the booths. Owing to natural limitations neither the ladies or I could see over the heads of the crowd. Bill craned his long neck and relayed the news in a disgusted tone that the place was Madame LaTour's Chic Parisienne Beauty Shoppe and that as nearly as he could make out, several female victims at that moment were undergoing preliminary torture on the sacrificial altar.

He suggested we should back away and find a less crowded thoroughfare, but the ladies insisted on getting a nearer view from the ringside.

"Go ahead," said Bill. "Try to get in. If you can worm your way into that mob you are a better man than I am Gunga Slim!"

As neither Bill nor I showed any inclination to jeopardize our precious lives in a vain attempt to bore a hole through the solid mass, we were instructed to remain where we were for a few minutes. The ladies in some mysterious manner known only to the weaker branch of humanity oozed into the crowd and disappeared like—like—dash it all—what shall I say? Like the foam on the river, like the birds that fly away South in the fall of the year, like the flowers that bloom in the spring, tra-la-la, or like money on a vacation trip. In a word, as you might say, they just naturally vanished.

"This kind of thing," said Bill, "sometimes causes me to wonder if the well known human race is going backward instead of forward."

"What kind of thing?" I inquiried. "Can't you be a little more explicit? I am not a mind reader."

"Look around this place," Bill returned. "Here is an industrial exhibition, representing the inventive, commercial and manufacturing genius of a great city. People are given an opportunity of seeing the foundation on which the prosperity of the city rests. Their comfort, convenience, pleasure shelter, food, clothing, their very existence depend on the continued functioning of these industries. The products you see here are the culmination of intense research work over a long period of years. A vast army of men has devoted years to the perfection of the various pieces of equipment. The entire assemblage is a mighty tribute to and is emblematic of the onward march of civilization and in the face of all this what do we find?"

"Well," I said. "I never was any good at conundrums. I'll bite. What do we find? I know one thing. I don't believe we shall ever find our wives unless the authorities decide to drain the place after the manner of a swimming pool."

"Never mind about the wives," said Bill. "You can't lose them unless they want to get lost and in that case you might just as well write 'em off the books and forget 'em. I'm asking you about this exhibition. What do we find? Notwith-

A LEXICON OF TECHNICAL TERMS

(*Continued from Data Sheet No.* 684)

Transverse Strength (*Cross Breaking Strength*)

The maximum load in pounds to break a test bar supported freely at the ends when loaded at the mid-point between the supports.

This test is used primarily for stiff or rigid materials which will allow only a comparatively small amount of deflection or bending before rupture.

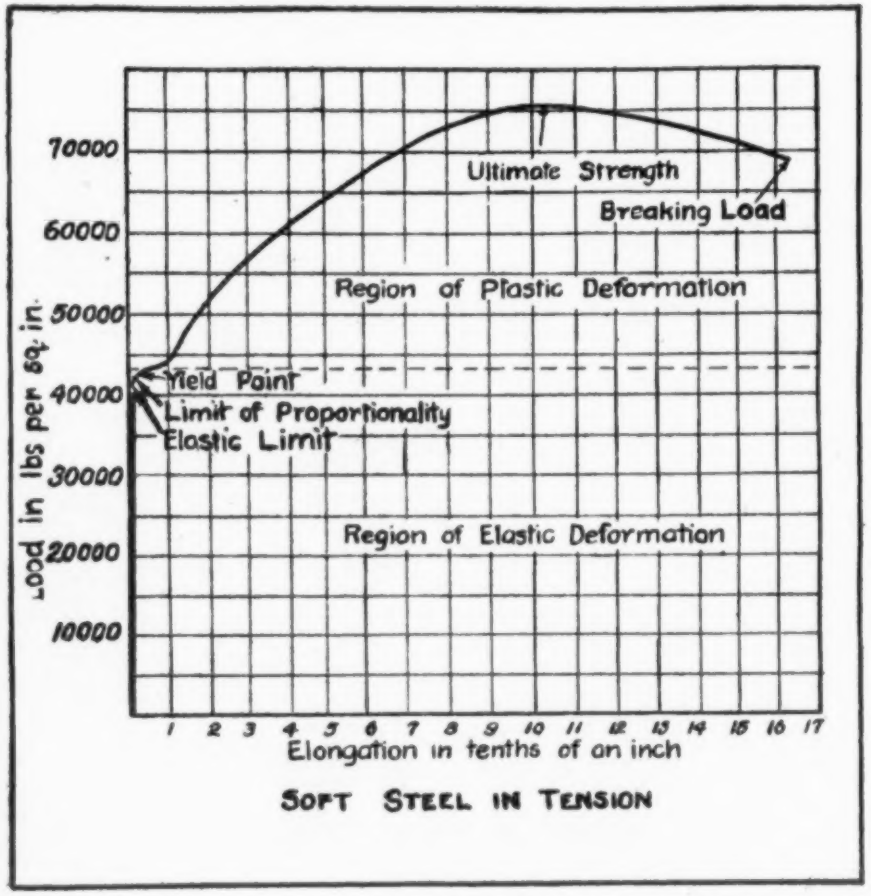


FIG. 1—DIAGRAM GIVING A GRAPHIC REPRESENTATION OF THE EFFECT OF A GRADUALLY INCREASING TENSILE STRESS ON SOFT STEEL

(*Continued on Data Sheet No.* 686)

A LEXICON OF TECHNICAL TERMS

(*Continued from Data Sheet No.* 685)

This is the most common test for the cast irons. This is known also as the *beam test* and is commonly used on such rigid materials or assemblages as built-up beams, rolled shapes, etc. This is an important test to determine deflection and permanent set for springs, axles, etc.

Material	Pounds per square inch
Gray cast iron	2500-3500
White cast iron	3000-5000
Semi-steel	3000-5000

(1¼-inch diameter specimen and 12-inch supports)

Elastic Limit

The maximum allowable load (or unit stress) at which the deformation is restored upon removal of the load. This is not a well defined point and has not been determined accurately for all alloys and kinds of stress. Some average figures follow:

Material	Pounds per square inch	
Wrought iron	23,000	Tension values
Mild steel	40,000	Tension values
Malleable iron	35,000	Tension values
Cast iron	0-10,000	(Average 6000)
Cast iron	about 20,000	(Compression)

Limit of Proportionality

The maximum load (or unit stress) at which the ratio of stress to deformation is constant. In most cases slightly above elastic limit.

Malleable iron—15,000 (tension); 13,000 (compression).

White and gray cast iron—Not apparent.

Yield Point

That load or unit stress at which the material continues to deform with no change in loading.

Material	Pounds per square inch
Wrought iron	25,000
Mild steel	43,000
Malleable iron	27,500

Endurance Limit (*Fatigue Limit*)

The greatest load or unit stress at which a material can withstand an indefinite number of reversals of the load or stress without failure.

Material	Pounds per square inch
0.37 carbon steel	33,000
Alloy steel (heat treated)	40,000-100,000
Malleable iron	25,000
1.2 carbon steel	46,000

(*Continued on Data Sheet No.* 689)

THE FOUNDRY DATA SHEET, SEPT. 15, 1927
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

standing the marvellous displays on every hand, we find the greatest mob of people jammed around a place where women are having their faces twisted and painted out of all resemblance to human beings.

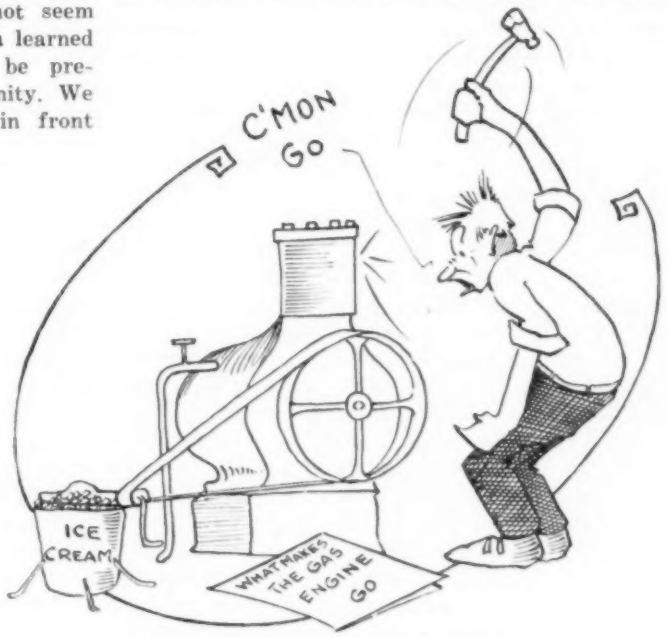
"It would be comical if it was not so pitiful to see how meekly they submit to a course of treatment which they would resent bitterly and regard as torture if it was not fashionable. The implicit and childlike faith they repose in these renovating shoppes really is pathetic. They still believe in miracles. A woman with a face like a lump of coke or a frost bitten turnip enters one of these places and when she emerges a few hours later—such is the power of auto suggestion—she hurries along with downcast eyes to avoid embarrassment from the admiring stares of bold eyed men.'

"Oh! well," I said, "when it comes to a final showdown I do not seem to recall any instance where a learned society struck a medal to be presented to a man without vanity. We may not waste much time in front of a glass, but every man has a blind spot some place in his mental makeup. Usually it takes the form of a belief that if we had another man's job we could handle it much better than he does." "That's one shot right on the bull's eye," Bill agreed. "I had a letter the other day from a man who said he was contemplating starting a foundry. He admitted he had no knowledge of the business, but he was located in a town which had no foundry and he thought the venture would pay. Most of the castings would be required for oil refineries. Coke from these refineries was available at a low figure, pig iron could be imported by water, and the proprietor of a local junk yard possibly might become interested in the enterprise. He wanted to know the minimum capital on which he could start and what kind of equipment would be required.

"In my reply I pointed out to him that long distance advice would be of little service. What he really needs is an expert foundryman to visit the city, appraise the situation and furnish a report. This proposed foundry primarily is intended to function as a local industry, therefore the first point to determine is what volume of castings will be required to meet the local demand. The second point is to discover the general character of the castings that will be required.

"With a definte understanding on these two main features he will be in a position to acquire the necessary property, erect a suitable building and equip it. The question of future expansion usually is a secondary consideration. In some instances it may be advisable to erect additions to an existing plant and in other instances, circumstances may render it expedient to erect a new plant in a different locality. This latter feature is particularly applicable in a rapidly growing city.

"Character of the castings to some extent will determine the type of building and will exert an important influence on the selection of the necessary mechanical equipment. The question of a suitable sand supply also must be taken into consideration. Fine sand suitable to the molding of small, thin castings, is not satisfactory for making large, heavy castings. Only a practical foundryman is competent to pass judgment on these items.



THE ENGINEER TRIES TO COAX 'ER

"Where large castings are made, a crane will be required and this feature must be anticipated in the construction of the building. One or more ovens will be required for drying the cores and possibly for drying some of the molds.

"With highly skilled molders and a suitable grade of sand, many large and difficult castings may be made in green sand, but where this class of men is not available, castings may be made in dried molds with men less highly skilled in the intricacies of the trade. In some instances, of course, molds must be dried irrespective of how or by whom they are made. This feature depends to some extent on the size, weight and shape of the casting and to a greater extent on the purpose for which it is intended.

"In some localities the question of a suitable fuel is important, but in this case that is settled by proximity to oil refineries where coke is plentiful and cheap. Petroleum coke is suitable for core and mold ovens, but he may have to do considerable experimenting before he can melt iron satisfactorily with it. I think this species of coke is too soft and dense to support the burden or to permit the proper distribution of the blast in a cupola. I have no personal knowledge that petroleum coke is being used as a fuel for a cupola, but I suggested that a general inquiry among the foundrymen in his territory would disclose if it is used, also the manner in which it is manipulated. An outsider is not competent to advise how many or what class of molding machines to employ. An expert foundryman on the ground and familiar with all the local conditions is the only man justified in offering advice. However, I told him that if he was to get in communication with makers of molding machines and supplies advertised in THE FOUNDRY they will be glad to consider the problem, and submit prices and production figures from which he will be in a position to draw his own conclusions. The same applies to the selection of a cupola. Manufacturers of this type of melting equipment have brought it to a high state of perfection and probably are in a position to advise on the question of using petroleum coke in a cupola of standard design, or whether it may be necessary to design a special cupola for the utilization of this kind of fuel.

"Summing up the situation, the logical procedure is to secure the services of a foundry consultant, either some person who may be known to him already, or one whose card may be found in the advertising section of THE FOUNDRY. Successful production of castings is a highly skilled, intricate business and requires the

(*Concluded on Page* 735)

Proper Sulphur—Manganese Ratio *Must Be Maintained*

By L. E. Gilmore

FOR THE production of good quality malleable castings a fundamental essential is that the carbon of the white iron casting be in chemical combination, and in such combination that proper heat treatment, or *annealing*, will dissociate or precipitate the carbon as free or temper carbon. Assuming that the carbon and silicon are balanced properly; that the casting temperature and speed of cooling are such that the carbon is all combined in the white casting, and that the annealing conditions are ideal, there is still the effect of the sulphur-manganese relation which may ruin what otherwise would be a perfect product. The present discussion will be confined to consideration of the requisite relation between sulphur and manganese to produce good malleable.

For years foundrymen have looked on sulphur as responsible for many foundry troubles. It has served for many an alibi. In recent years, with more familiarity through increased knowledge, the ogre sulphur, has lost some of its terrifying aspects. With proper control it can be rendered at least practically harmless and in some cases even has been used to attain certain desired ends.

Among malleable founders, especially those using cupolas, the regulation of sulphur has been a vital necessity. Many a weak and brittle casting has been charged rightly to the account of high sulphur. Yet, had sufficient manganese been used in the mix, these high sulphur castings would have been strong black heart malleable. The harmful effect of sulphur may be neutralized by the proper use of manganese.

Even when the sulphur is comparatively low, as in air furnace, open hearth or electric furnace practice, care must be taken to keep the manganese above a dangerous minimum, as at times pig or scrap iron may run unusually low in maganese. Whatever the percentage of sulphur, manganese must be present in excess of a dangerous minimum which increases or diminishes as the sulphur varies. The dangerous minimum for manganese is the percentage required to form manganese sulphide with the sulphur present in the iron.

The detrimental effect of sulphur is believed to be caused by the presence of iron sulphide which in some manner holds a certain percentage of the carbon in combination eve after drastic annealing. However, sulphur has a greater affinity for manganese than for iron and if sufficient manganese is present, will unite with it to form manganese sulphide in preference to uniting with the iron. Manganese sulphide has not the harmful effect of iron sulphide in preventing the complete precipitation of the carbon in the form of temper carbon during the anneal. The ratio of manganese to sulphur in the compound manganese sulphide is approximately 1.7 to 1. To neutralize completely the harmful sulphur effect, practical experience indicates that it is necessary to have at least some slight excess of manganese present over that required theoretically to produce manganese sulphide.

Two charts have been made, Fig. 1 to show the manganese sulphur relation in the usual air furnace, open hearth, or electric malleable, and Fig. 2 for cupola malleable. These charts not only show the manganese sulphur relation but also serve as a practical guide for determining rational percentages of manganese for varying sulphur content in the iron as cast.

Lines *A-B* in Fig. 1 and *E-F* in Fig. 2 show the theoretical percentage of manganese required to form the compound manganese sulphide with increasing percentages of sulphur. In practice we find that it requires some slight excess of manganese to remove the harmful sulphur effect. Therefore lines *A-B* and *E-F* represent a dangerous minimum for manganese. Any sulphur-manganese analyses which when plotted are just above and close to, the lines *A-B* or *E-F* are in the shoals which malleable mariners should avoid. Any plotted analyses which fall below these lines

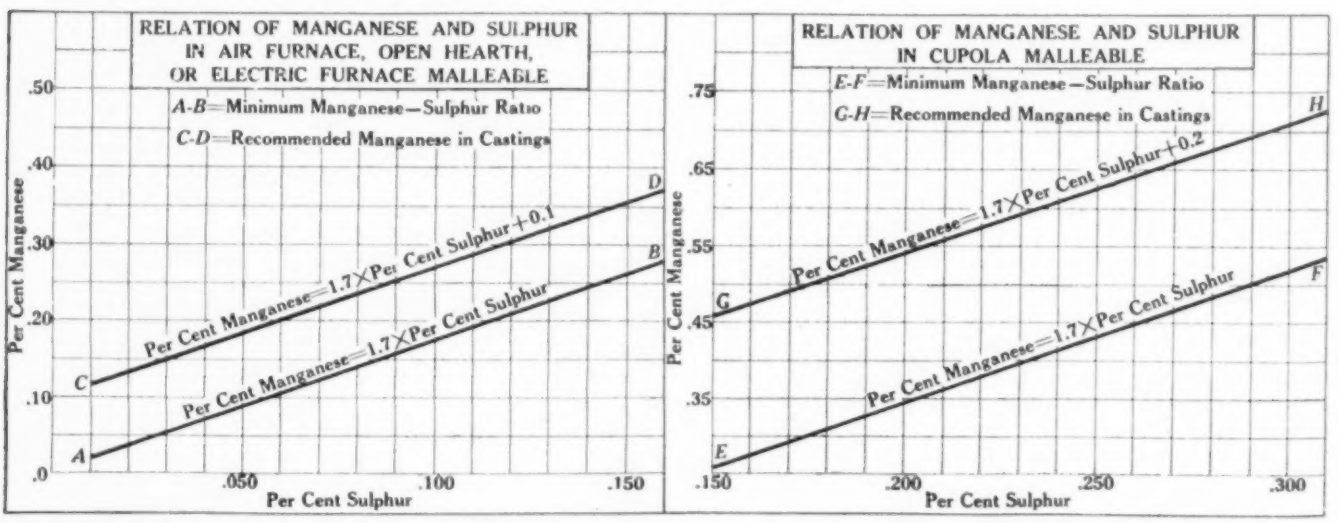


FIG. 1—GRAPHIC DIAGRAM OF SULPHUR-MANGANESE RATIO FOR AIR FURNACE, OPEN HEARTH, OR ELECTRIC FURNACE MALLEABLE. FIG. 2—CUPOLA MALLEABLE CONTAINS HIGHER SULPHUR AND THE ADDED MANGANESE CONSTANT ALSO MUST BE INCREASED

indicate metal that cannot be made black heart no matter how long or drastic the anneal. The fracture of such an annealed iron will be dove gray to crystalline the more crystalline iron being the further below the lines *A-B* or *E-F*.

Sections of this iron polished and etched and examined by aid of a microscope will show matrix composed largely of pearlite. In other words the change of carbon from the combined to the free condition is incomplete, about 0.8 per cent carbon being retained combined. For this reason the casting is somewhat hard and brittle as compared with regular black heart malleable. In general such metal has the characteristic fracture, structure, and physical properties of white heart or European malleable in parts of castings where cross sections are too thick for more or less complete decarburization.

The lines *C-D* in Fig. 1 and *G-H*, Fig. 2 are based on numerous experiments and practical experience and show the percentage of manganese in relation to sulphur which produces the best and softest black heart malleable under works conditions. These lines represent the percentage of manganese in relation to sulphur which should be present in the iron when cast. Since both charts are drawn to the same scale, it will be noted that line *C-D* is closer to *A-B* than *G-H* is to *E-F*. In other words, for air furnace, open hearth or electric furnace iron it is not necessary to keep the manganese so far above the dangerous minimum as is the case with cupola metal. The reason for this is that both the manganese and sulphur can be controlled within narrower limits in the air furnace, open hearth and electric furnaces than when using the cupola for melting. Therefore, the cupola requires a larger margin of safety than do the other furnaces. Lines *C-D* and *G-H* are high enough above the minimum lines so that for their respective furnaces, fluctuations of manganese will not come too close to the minimum. Moreover, *C-D* and *G-H* will not give so great an excess manganese as to produce the harmful effect that high manganese has, that of retaining some of the carbon in the combined condition after annealing. However, it is well to bear in mind that there is much more danger from excessive sulphur than from excessive manganese, for the reason that the slightest excess sulphur over that necessary to form manganese sulphide results in a white heart fracture. On the other hand some excess manganese is necessary to produce a black heart fracture, and it is only when a large excess of manganese, over that required to neutralize the sulphur, is present, that its retarding action on the annealing operation develops.

To illustrate further the relation between manganese and sulphur, formulae are derived for the four lines. As *A-B* and *E-F* are different parts of the same line, they have in common the formula $y = 1.7X$; where X = percent sulphur and y = per cent manganese. The formula for *C-D* is $y = 1.7x + 0.10$ and the formula for *G-H* is $y = 1.7x + 0.20$. Substituting these values for X and y, the formula for *A-B* and *E-F* becomes percent manganese = 1.7 x percent sulphur. *C-D* for air furnace, open hearth or electric furnace iron becomes percent manganese = 1.7 x percent sulphur + 0.10, and *G-H* for cupola metal becomes percent manganese = 1.7 x percent sulphur + 0.20.

Thus the percentage of manganese in the casting should be 1.7 times the sulphur percentage, (minimum manganese), plus a constant. The constant added for cupola iron is twice that for iron melted in other furnaces, due to the higher sulphur, and the likelihood of greater variation in both manganese and sulphur in cupola iron.

A glance at Fig. 2 shows that for 0.150 percent sulphur, the manganese recommended is 0.455 percent, or three times the sulphur content, and for 0.250 percent sulphur the manganese is 0.625 percent or 2½ times the sulphur. Similarly in Fig. 1 for 0.070 percent sulphur, the manganese is 0.22 percent or about three times as great; and for 0.120 percent sulphur, the manganese is 0.30 percent or 2½ times the sulphur. From this it is evident that a general rule for the usual ranges found in works practice is that manganese should be about 2½ to 3 times the sulphur to produce good black heart.

Presents Chart

MODERN foundry, metallurgical investigations have nullified to a great extent the difficulties caused by sulphur. This end is accomplished by adding enough manganese to form manganese sulphide instead of iron sulphide. Steel, iron and malleable founders have found this principle effective and in this article the author gives some of the details as applied to malleable cast iron melting practice.

L. E. Gilmore, Crane Co., Chicago, author of this article, has had extensive practical experience in the production of malleable iron in the air furnace, open hearth furnace and the cupola. He also has had several years experience in steel manufacture. Mr. Gilmore was graduated from the Massachusetts Institute of Technology, Cambridge, Mass. in 1905 *and has been associated with the Malleable Iron Fittings Co., Branford, Conn., Stanley G. Flagg & Co., Pottstown, Pa., and the Illinois Malleable Co., Chicago, as metallurgist, and until recently was superintendent of the malleable division of the last named company. During the five years covering the war period he was engineer of tests for the Bethlehem Steel Co., Bethlehem, Pa. For the past two years he has been with the Crane Co., Chicago, engaged in industrial research.*

Bill Is Introduced To a Foundryman

(*Concluded from Page* 733)

services of a man with broad general training in the technical, and commercial field to launch properly, and incidentally to keep in operation afterward."

"Talking about long distance advice," said Bill, "reminds me of the story of the farmer who wrote a letter complaining about his gas engine. I clipped the story out of a paper the other day. Here it is. Read it for yourself. Half the charm lies in the composition:

Gents: The gas engin you sent me stops when there aint nothin the matter with it thats the truble it wudent bee so bad if it stoped for sum reeson and anybody noes theres reesons enuf for it to stop. I receeved that there book which you sent me which is named What Makes the Gas Engine Go. I aint read it yet becus whats the use readin it when I dont care what makes it go as long as it goes which mine dont only now and again. What I want to no is What Makes the Gasoleen engin stop. If you got a book called that send me one. I want to know what makes my engin stop when everything is ok and nothing is the matter except that it must be a rotten engin. Yours in pain Mike Ott, Pinkytown Pike.

Ask Me Another ? ? ? ? ?

Brass Foundry Engages in Popular Fad

FOR several years E. A. Williams & Son, Inc., Jersey City, N. J., has issued a monthly bulletin entitled *Brass Foundry Facts*, dealing principally with the almost numberless angles of the nonferrous foundry industry. The issue commemorating the seventieth anniversary of the founding of the firm was accompanied by a questionnaire designed to test the foundry knowledge of the readers. The succeeding issue contained the answers to the various questions. Four prizes were awarded to the four contestants who returned the best sets of answers.

1. *What is* 85-5-5-5? An alloy consisting of 85 parts copper, 5 parts each tin, lead and zinc.
2. *What is babbitt metal?* An alloy used for bearings, composed usually of lead, tin, antimony and copper.
3. *What is the skin of a casting?* The outside surface.
4. *Who is credited with the invention or discovery of babbit metal?* Isaac Babbitt.
5. *What is four ounce metal?* Bell metal. An alloy made by adding 4 ounces of tin to 16 ounces of copper—in other words, 20 pounds of tin to 80 pounds of copper.
6. *Why is Lake Copper so called?* It comes from Lake Superior regions of United States.
7. *What part of a pattern is usually painted black?* Standard pattern colors, unfinished surfaces, formerly used to show core print.
8. *What are composition castings made from?* Remelted mixed red metal scrap or turnings.
9. *For what purpose are most phosphor bronze castings used?* Bearings.
10. *What is the chief characteristic of manganese bronze?* Strength.
11. *What are the chemical symbols for*—(1) *Aluminum?* (2) *Copper?* (3) *Lead?* (4) *Manganese?* (5) *Tin?* (6) *Iron?* (1) Al. (2) Cu. (3) Pb. (4) Mn. (5) Sn. (6) Fe.
12. *What are the chief functions of tin in a nonferrous alloy?* To harden and strengthen.
13. *Manganese bronze is one of the strongest of the nonferrous alloys—therefore is it suitable for castings designed to resist great hydrostatic pressure?* No.
14. *What is meant by a dry sand mold?* A mold that is baked in an oven before the molten metal is poured into it.
15. *What is a gate of patterns?* A number of patterns fastened to one gate or runner so that they may be molded at one operation.
16. *Why are turnings (chips) poor material to make castings from?* They usually contain foreign matter such as iron, emery. etc., also, they oxidize easily, which increases the likelihood of blow holes and muck.
17. *What is a cheek?* That part or parts of a mold between the cope and drag; as where a three or more parted flask is used.
18. *What is a gagger?* An *L* shaped piece of iron or steel rammed up in a mold to hold the sand in place.
19. *What is the top half of a two parted mold called?* Cope.
20. *What is the bottom half of a two parted mold called?* Drag or nowel.
21. *What is the chemical analysis of the bronze known as navy department composition G?* 88 parts copper, 10 parts tin, 2 parts zinc.
22. *What is high brass?* An alloy of copper and zinc containing a large amount of zinc.
23. *Why are Straits tin and Banca tin so named?* They come from the Straits Settlement and the Isle of Banca.
24. *Who was the first brass and iron foundryman?* Tubal Cain. Genesis IV, 22.
25. *Why is composition so called?* Because it is made up of a composite lot of scrap metal.
26. *What is generally admitted to be an allowable variation in the individual weights of a series of castings from the same pattern?* Five per cent.
27. *What does a molder say when he is given a well-made pattern painted with standard pattern colors?* I can mold the castings more intelligently because I know what surfaces are machined.
28. *What is the approximate weight of a cubic inch of* (1) *cast bronze?* (2) *cast iron?* (3) *aluminum?* (1) 0.3195 (2) 0.2604 (3) 0.0963 pounds.
29. *What is elastic limit?* That load at which the deformation ceases to be proportional to the stress.
30. *What does S.A.E. mean?* Society of Automotive Engineers.
31. *What is the alloy referred to as navy department specification, composition H?* Journal bronze. Copper 82-84 per cent; tin 12.5-14.5 per cent; zinc 2.5-4.5 per cent; lead (max.) 1.00 per cent.
32. *What physical properties should the alloy known as navy department specification composition G have?* Minimum tensile strength 30,000 pounds per square inch; minimum yield point 15,000 pounds per square inch; minimum elongation in 2 inches—15 per cent.
33. *What does a foundryman say when he gets a battered old pattern, warped out of shape to work from, and then gets bawled out because the resultant casting does not look like 22 karat gold?* !?*, or words to that effect.
34. *Is so-called ingot bronze and brass as good as new metal having the same analysis?* No—Ingot metal is made from scrap and turnings built up with enough copper, tin, etc., to produce the required mix—new metal is 100 per cent new metal.
35. *What is a vernier?* A device invented in 1631, consisting of an auxiliary scale which agrees with a definite part of the main scale, but containing one more or one less division used for measuring to small fractions.
36. *What does a machinist mean when he speaks of a jig?* A device used to facilitate the machining of work or to insure its exact duplication.
37. *What is the chief physical characteristic of aluminum?* Lightness.
38. *What kind of a tool is a knurl?* A tool for forming a regular roughened surface on a round knob, etc., to assist in its being turned by the fingers, or to improve its appearance.
39. *What does a machinist use a lap for?* Producing a superfine fin-

ish and accuracy to the work after it has been hardened and ground.

40. *What does a machinist use a muffler for and what is it?* A hollow cylinder placed over a piece being turned in a lathe and held in a steady rest. It is used when the piece being turned cannot be conveniently held in the steady rest directly.
41. *Why is ordinary so-called furniture varnish unsuitable for wooden patterns?* The dampness of the molding sand causes the varnish to become sticky—this prevents the pattern from drawing clean from the sand—sometimes it spoils the whole mold.
42. *What part of a lathe is a lathe dog?* No part. It is a clamp attached to cylindrical work being turned in a lathe and used for driving it while it is being turned.
43. *Is there any difference between zinc and spelter?* No—these are two names for the same metal.

Superheats Direct Metal for Auto Castings

(*Concluded from Page* 715)

manifestation in the manner in which the mixer is operated. To depress the spout so that metal will flow into the waiting ladle, an attendant shoves forward the lever of an electric controller. So long as he holds the lever down the mixer will continue to roll forward. When he releases his hand the lever automatically reverses and the mixer rolls back to normal position where the power is cut off and the mixer comes to rest. Any hazard incident to the human factor practically is removed. Unless the attendant deliberately tips the vessel and then holds it in that position, no iron can come out of the mixer.

Although of a well known standard make, the two 15-ton electric furnaces in which the iron receives its final treatment, have been adapted and adjusted by Ford engineers to fit their special requirements. For example they are mounted entirely above the floor and this in turn throws the mechanism of the controlling apparatus high up on a level with the platform extending for some distance at a level of the center line of the mixer.

At present iron borings are packed in stove pipe containers and charged in the cupola, but experiments practically are completed on a method for charging the borings directly into the electric furnace. These experiments have proved that approximately 1 ton of borings easily may be added to a 15-ton charge of molten iron in the electric furnace without retarding the superheating time to any material extent. Under the proposed arrangement borings will be stored in a large bin and fed by conveyor into the charging spout of the electric furnace co-incidentally with the stream of iron from the transfer ladle. Since the analysis of these borings approximates closely the regular analysis of iron from the mixer, the addition of the borings does not introduce any disturbing element.

Typical report cards for a day's operation show that the charges for the cupola were made up of remelts 2800 pounds (70 per cent) and steel scrap 1200 pounds (30 per cent). Analysis of this metal was: Silicon 1.00 per cent, sulphur 0.17 per cent, phosphorus 0.29 per cent, manganese 0.60 per cent, total carbon 3.00 per cent. This iron was mixed with direct metal from the blast furnace with a silicon content of 3.00 per cent. The resulting metal was superheated in the electric furnace and showed an analysis of: Silicon 1.81 per cent, sulphur 0.07 per cent, phosphorus 0.35 per cent, manganese 0.80 per cent, total carbon 3.50 per cent.

Average time for superheating a charge of 15 tons in the electric furnace is 20 minutes. Average rise in temperature is 250 degrees Fahr. Average kilowatt-hour consumption is 100 per ton and the average electrode consumption is 6 pounds per ton of metal. Two electric furnaces are constantly in use. They are charged and tapped alternately.

Faked Foundry Facts

The Skull Cracker

Hoist Firms Merge

Recently plans for a merger of the Brown Hoisting Machinery Co., Cleveland, and the Industrial Works, Bay City, Mich., were approved by the directors of both firms and will be effective when ratified by the stockholders at meetings to be held in the near future. The Brown company designs and manufactures hoisting and conveying appliances, handling machinery, locomotive cranes, ore unloaders, traveling cranes, etc. The Industrial Works manufactures similar equipment. Consolidation it is claimed will eliminate duplication and overlapping of product.

Institute of Metals Will Meet

As mentioned in a previous issue of THE FOUNDRY, the institute of metals division of the American Institute of Mining and Metallurgical Engineers will hold its annual meeting jointly with the American Society for Steel Treating at Detroit from Sept. 20 to 22, inclusive. The Institute will hold sessions each of the three days and the program will include papers on the manufacture, use and treatment of nonferrous materials. Meetings will be held at the Book-Cadillac hotel with one joint session with the Steel Treaters on Wednesday at 2 p. m. at the Statler hotel. The dinner of the Institute will be held on Wednesday, Sept. 21, at 7 p. m. at the Book-Cadillac hotel. E. Blough, technical director, Aluminum Co. of America, will be the speaker. Fourteen papers will be presented at the technical sessions and will include "Commercial Forms and Applications of Aluminum and Aluminum Alloys," by P. V. Faragher; "Principles Covering the Heat Treatment of Aluminum," by H. H. Richardson, "Physical Characteristics of Commercial Copper-Zinc Alloys," by W. H. Bassett and C. H. Davis; "Nickel and Monel Metal," by C. A. Crawford; "Equilibrium Relations of Aluminum Silicon and Aluminum-Iron-Silicon Alloys of High Purity," by E. H. Dix Jr. and A. C. Heath, and "Heat Treatment of Aluminum-Silicon Alloys."

Utilizes Circular Saws in the Pattern Shop

By Walter C. Ewalt

THE circular saw is one of the most important tools used in the pattern shop since it economizes in both time and labor. The originator of the circular saw probably secured the idea from the stone and steel wheels or disks which were used in other classes of work, such as grinding and polishing. Applying the teeth, which are similar in shape to those found on a steel hand saw, was only a short step after the idea of the circular steel plate was developed. While the originators of the

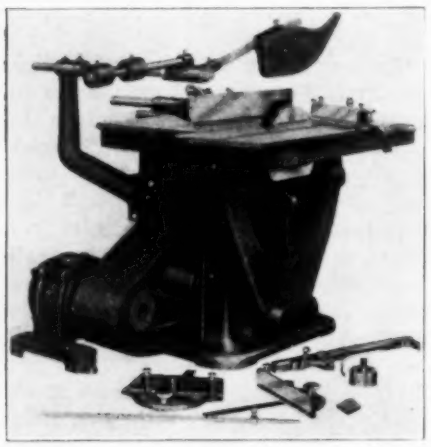


FIG. 1—UNIVERSAL SAW BENCH SHOWING SAFETY FEATURES

first circular saw are not known, it is thought that the first saw of that type made in the United Sates was produced by Benjamin Cummings at Bentonsville, N. Y., in 1914.

A circular saw may be adapted to a variety of work when it is mounted on a modern saw bench. This universal machine may be used for cutting different shapes, sizes and angles and for rip sawing, cross cut sawing, dadoing, mitering, ripping to width and cross cutting to length. Many of these operations may be accomplished quickly since the table is ruled for length and width measurements and universal gages operating in table grooves permit the sawing of angles from 30 to 150 degrees without previous calculations. As the larger machines permit a wider range of work, a machine of that type will be mentioned first. A type of universal saw bench which is adapted to pattern-shop work is shown in Fig. 1.

Since a universal saw bench is made by several equipment manufacturers, differences in design may be noted. However, a description of one type will indicate the advantages of this equipment in the pattern shop. The table on the machine is supported by a strong cast iron base. The table on the machine shown in the illustration measures 44½ x 38½ inches and is made in two sections. The stationary section is 21 inches wide and the sliding section is 17½ inches wide. The sliding table is mounted on a tongued cross slide and moves past the saw. This feature is utilized in cutting off and dado work. The cross slide frame is gibbed to the main table frame and may be drawn away 4 inches to permit the use of the dado head or wobble saw. The stationary table is ruled in eighths.

The bench is equipped with two saw arbors to permit the attachment of two different types of saws to the machine, such as the rip and the cross cut. The arbor yoke is supported on the front end by a disk bearing and on the rear by a shoulder bearing. The yoke revolves easily by a hand wheel engaging a worm and gear, thus bringing either the rip or the cross cut saw into position.

The entire table tilts to an angle of 45 degrees for bevel sawing, as is shown in Fig. 2. The table is operated by a hand wheel, worm and gear and has a locking device which holds the top firmly at any angle up to 45 degrees. Several gages are provided on the bench. The miter and cut off gage, which is located in the sliding table, swings at angles from 30 to 135 degrees. It has 18-inch and 36-inch auxiliary rods and stops, which are used to determine the length of the cut off. Two universal gages operate in table grooves on each side of the saw. A ripping fence may be used on either side of the saw or secured to any angle not in line with the saw, on either the stationary of the sliding table. A micrometer device may be used to secure accurate adjustment of the fence. The circular segment gage and the table graduations are shown in Figs. 4 and 5. The circular segment gage is especially useful to the patternmaker.

While judgment concerning the proper temper and tension necessary for a good saw rests with the manufacturer, the care of the saw is a duty of the operator. If work is to be accomplished accurately and speedily, it is necessary that great care be exercised in sharpening the saw. The thickness of the circular saw is gaged by the Birmingham wire gage as is

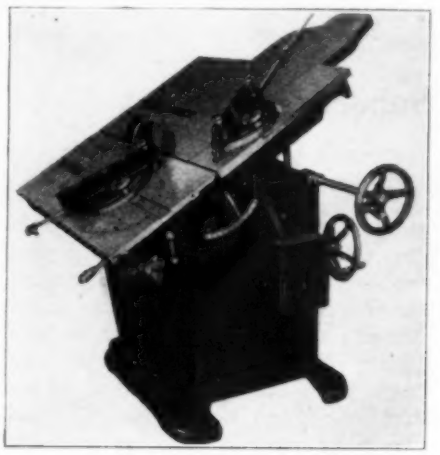


FIG. 2—THE TABLE MAY BE TILTED TO A 45 DEGREE ANGLE

shown in Fig. 3. The various shapes of saw teeth also are shown in Fig. 3. The angles shown are considered safe and are recommended by safety inspectors for use in the pattern shop. While manufacturers follow the same thickness gage, some vary the diameter of the hole. The diameter, thickness gage and size of hole given by one manufacturer is as follows:

Diameter Inches	Thickness Gage	Size of Hole Inch
1	24	3/16
1½	24	3/16
2	23	3/16
2½	22	3/16
3	21	1/4
3½	20	1/4
4	19	3/16
5	19	3/16
6	18	3/16
7	18	3/16
8	18	7/16
9	17	7/16
10	16	1
11	16	1
12	15	1
14	15	1 1/16
16	14	1 1/16
18	13	1 1/16

When filing the saw, the tooth back of the cutting point should be lower than the point itself. This gives more clearance and also room for the sawdust. When sufficient room is not allowed, the saw will bind and heat on the rim. The base of the tooth always should be filed with a round file. Many saws are ruined by leaving a square corner at the base of the tooth, which generally results in a crack. This feature also applies to cut off saws. Usually saws of this type are filed on a bevel all of the way and a sharp corner is produced. However, if the bevel is filed about half way and the corner then rounded out, the saw is less liable to crack and will clear better. Great care must be exercised in using an emery wheel to sharpen the teeth or the temper will be withdrawn.

The set of the saw is governed by the kind of wood being cut. Soft woods require the most set and hard woods the least. This feature of saw sharpening was discussed in the article on hand and band saws which previously has appeared.

The saw which runs at great speed creates a centrifugal force which causes the saw to stretch and expand in diameter. Under this condition the saw will not run steadily. This difficulty is overcome in the manufacturing process which produces a uniform tension throughout. However, the tension may be altered due to several causes, such as the arbor bearings running hot, a reduction in the diameter of the saw due to repeated filing, dull teeth resulting in heating of the teeth, insufficient set, not enough throat room for the sawdust, back teeth too high, accummulation of gum on the teeth, running work out of line, etc.

The correct temper of a saw should

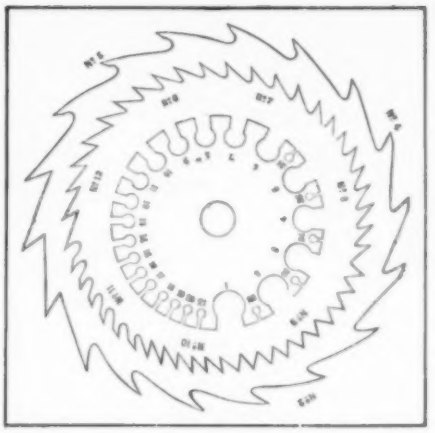


FIG. 3—SHOWING THE VARIOUS SHAPES OF SAW TEETH

be determined by the filer. He is able to determine whether the saw is too hard or too soft while filing. If the temper is not correct, it is necessary to send to saw to the manufacturer. The speed of the saw probably is the most essential, since accidents may occur if the speed is too high causing the saw to heat, and the saw will labor if run too slow. The following table shows the speed of saws according to the diameter, the table being based on a periphery speed of 9000 feet per minute.

Size of Saw Inches	Revolutions per Minute
8	4500
10	3600
12	3000
14	2585
16	2222
18	2000
20	1800
22	1636
24	1500

Skimming of molten aluminum and its alloys should be avoided as it leaves the metal unprotected and increases losses. Skim just before pouring and stir thoroughly for a short time, disturbing the surface as little as possible.

Steel Loses Identity in Semi Steel

Question—We would like to know how much steel we would have in our iron after using a mixture of 600 pounds pig iron, 400 pounds return scrap, and 50 pounds of steel scrap for 30 days; or in other words, what is the cumulative effect of the addition of steel scrap to the mixture. Also, would there be any danger of not securing a uniform metal if we use this amount of steel and tap the cupola into hand ladles?

Answer—Your question would seem to infer that steel retains its identity after being melted in the cupola. Steel is simply a low-carbon iron and when melted in the cupola absorbs carbon from the coke and mixes with the pig iron and scrap, entirely losing its identity. About the only effect 5 per cent of steel in the cupola would have would be to slightly change the grain size and cause the graphite to separate out in slightly smaller flakes. It also might tend to lower the percentage of carbon in the finished product, although this is not always the case as the steel sometimes picks up enough carbon from the coke to bring the average carbon of the metal up to the amount which the iron would have contained without the use of steel. In melting steel without a forehearth or mixing ladle you would be apt to run into irregular metal on account of the steel and iron not always being thoroughly mixed. As far as the effect of the returned scrap is concerned it would be practically negligible with the percentages used.

The Cutler-Hammer Mfg. Co., Milwaukee, has removed its Cleveland office from the Guardian Trust building to 1905 Guarantee Title building.

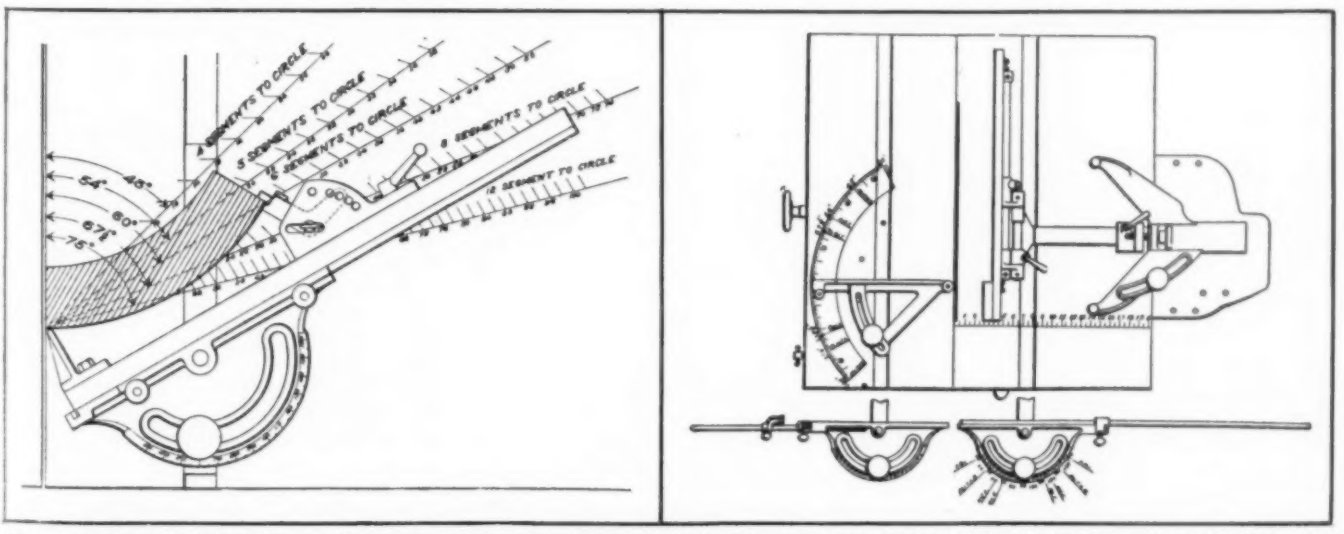


FIG. 4—CIRCULAR SEGMENT GAGE WITH ADJUSTABLE MITER GAGE, BAR AND LOCATING POINTS FOR CUTTING SEGMENTS. FIG. 5—NUMEROUS GRADUATIONS ON THE TABLE ELIMINATE THE NECESSITY OF MANY CALCULATIONS

WHAT OTHERS ARE THINKING

Abstracts Selected from the World's Foundry Literature

Describes Malleable Process

Malleable Cast Iron, by Marcel Guedras, *La Revue de Fonderie Moderne*, Paris, April 10, 1927.

This is the second article of the series. First the typical composition of the primary metal is given: Total carbon 2.8 to 3.4 per cent (no graphite); silicon 0.5 per cent, manganese 0.3 to 0.4, sulphur 0.10 and phosphorus 0.20. Various compositions of the secondary metal are given. The author reviews the physical properties of European white heart malleable. After reheating, the metal loses about 2 per cent of its weight and the size of the castings increases by about 1 per cent. The fracture of a casting which has been properly decarburized should present large grains regularly distributed. In massive pieces the center is not decarburized. Micrographs show concentrical zones. According to Stead, the outer surface is ferrite with silica coming from the sand; then comes a zones of ferrite, followed by ferrite and pearlite equally divided, followed by pearlite, the center being formed of cementite with layers of graphite and pearlite.

American malleable cast iron is not decarburized, but the carbon is precipitated. The properties are different. The mechanical characteristics of European and American malleable iron are given comparatively. The author recommends standardizing test bars. He states that good malleable iron is easy to machine and that bad results are due to the tool not being used at the correct angle, which should be that used for soft steel. In forging malleable iron the temperature of 550 degrees Cent. should not be exceeded. He states that American malleable does not stand the heat so well and is difficult to galvanize. The heat treatment of malleable iron is discussed. In the Ardennes region, which is the principal malleable center in France, the iron comes from Great Britain and Sweden. The composition of the charge adopted in the Ardennes is given, special attention being paid to the quality of coke, a substantial tonnage of which comes from Belgium.

Japanning Aluminum Castings

Cleaning and Baking Aluminum Castings, by Henry H. Smallwood, *Metal Industry* (London) July 29, 1927.

Success in japanning aluminum articles depends greatly upon the cleaning and handling operations after delivery to the japanning department. Before the foreman allows any cleaning to be done, he should find out about the melting point of the castings as the heat required is an important part of the cleaning. If the castings have been machined, the excess oil should be wiped off with rags, and the castings should be piled on trucks or placed in ovens that have no truck, then baked at a temperature 10 to 15 degrees higher than that required for the japan used. Castings that will not stand 350 degrees Fahr. should be washed first in gasoline or benzine to remove excess oil.

After baking, the castings should be sandblasted to remove the baked-on oil and grease. Do not sandblast any more castings than can be coated the same day as leaving of the cleansed work overnight permits the surface to oxidize. From the time of sandblasting, the casting should not be touched with the bare hands on the surface to be coated as this will cause non-adherance of the japan. The first coat of japan should have elasticity to stand expansion and contraction of the metal. Japanning temperatures should be determined accurately and properly maintained with good instruments. Overbaked castings showing the characteristic blue cast, should have the japan removed and the work done over again.

Graphite Distribution Is Important

Graphite in Gray Cast Iron, by P. Bardenheuer, *Stahl und Eisen*, Dusseldorf, May 26, 1927.

The author discusses the effect of the quantity of graphite in cast iron, the theory of graphite elimination and the connection of crystallization conditions of the graphite on its form and distribution. He also describes the influence of graphite separation on the properties of gray cast iron and refers to old and new methods to secure a favorable influence of graphite elimination.

In summarizing the author states that usually in a gray cast iron mixture, the volume of separated graphite is so large that its distribution and form in which it occurs in the structure can affect decidedly the strength properties. The formation of graphite depends upon the conditions under which it was separated. For instance, it is important whether the crystalization of the graphite eutectic results from a perfect germ-free melt or whether the same was induced through undissolved graphite residue. Some attempts show that the strength properties become influenced principally through the form and distribution and form of the graphite, and even more strongly so than through the structure of the metallic ground mass. A comparison of old and new endeavors to improve gray cast iron shows that the successful methods have resulted in a favorable influence on the distribution of graphite The influence of the metallic ground mass structure is of great importance for strength properties but less so than that of graphite formation.

Uses Forehearth

The Improving of Cast Iron by the Use of a Fore Hearth, by G. Simon, *La Revue de Fonderie Moderne*, Paris, June 25, 1927.

Considering that the use of the ordinary fore-hearth results in a premature cooling of the iron, the author draws attention to a method of heating the fore-hearth which obviates this drawback. In the case of a cupola where the tuyeres are high, the bottom of the cupola connects with the fore-hearth by an upward directed channel constructed in such a way that only the liquid iron can flow into the fore-hearth, the slag floating on the surface in the cupola. The fore-hearth is heated by an oil burner which is placed at the top. By blowing air through the burner at a higher pressure than that which exists in the cupola, the slag cannot enter into the fore-hearth even at the beginning of the operation. The fore-hearth is heated first for 30 to 40 minutes up to a temperature of 1450 degrees Cent. The hot gases are forced to pass through the cupola which becomes heated, thus accelerating the melting.

Another arrangement of this fore-hearth when the tuyeres are rather low placed is that of a fore-hearth divided into two chambers. Both the iron and the slag run into the first chamber which is connected with the second one in the same manner as the fore-hearth is connected with the cupola as mentioned previously.

Criticize the Double Diagram

On the Volume Change in Cast Iron During Solidification, by Kotaro Honda and Hikozo Endo, abstracted from report of Tokoku Imperial university, *Foundry Trade Journal*, London, Aug. 11, 1927.

The authors performed a number of experiments to confirm the decomposition theory of graphitization on the change of volume during solidification. The mean linear coefficients of expansion for graphite and cementite were determined between 20 and 1130 degrees Cent. These values then were used for calculating the theoretical change of volume when a partial decomposition of cementite takes.

The obtained values were compared with the observed values and coincided satisfactorily. The authors conclude that the favorable coincidence between the observed and calculated values confirms the view that graphite present in cast iron is the decomposition product of cementite precipitated from the melt at high temperature. Thus if the graphite present be a decomposition product, the double diagram of the iron-carbon system is not the correct representation of the observed facts.

The FOUNDRY Family Photograph Album

Upper Left

W. G. SMITH, Werner G. Smith Co. Cleveland.

Lower Left

CHAS. VICKERS, Nonferrous Editor, THE FOUNDRY

Upper Right

F. F. STOCKWELL, Barbour-Stockwell Co., Cambridge, Mass.

Lower Right

F. E. PATTERSON, American Steel Foundries, Chicago

The Shakeout

DAN M. AVEY, Editor

PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor

CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

¶ Appreciate Good Work

IN A competition staged by the American Foundrymen's association at the recent Chicago convention and open to apprentices at the molding and patternmaking trades from all over the country, three young men from one prominent Middle West plant were awarded prizes for the excellence of their work. The boys, naturally, were gratified at this public recognition of their efforts and without doubt entered upon the remainder of their apprenticeship course with renewed energy and enthusiasm. Executive officers of the firm thrilling to the same kind of pride which is felt by trainers of athletes, instructors of students and—presumably—owners of race horses, speed boats and ball clubs, decided the event was worthy of special commemoration. They wanted to give the boys tangible evidence of the extent to which they were interested in their progress. To show them that they held many interests in common and that any distinction awarded the boys was keenly appreciated by the management.

TO THAT end they staged a party and banquet one night at which these three young men were the guests of honor. In addition to the honorable mention and the prizes awarded by the American Foundrymen's association, the young men were presented with cash prizes and with words of eulogy and commendation by a management that apparently understands—and practices—the gentle art of combining business and sentiment. A medal or a diploma is appreciated by the average man or boy, but the yellow or green steel engravings issued by the government, still lead all others in point of popularity.

EVERY boy cannot be a Lindbergh and command the admiration of millions of people in every walk of life, but every boy—and others who no longer are boys—appreciate a pat on the back, a word of encouragement, a friendly smile or any other form of evidence that indicates his or their work has attracted attention and interest. Team work and co-operation make for success and one way to insure co-operation is to cultivate cordial relations between the shops and the front office. In this particular instance the ceremony of presenting the prizes was not delegated to the fourth assistant book keeper. The *Big Boss*, himself, accompanied by his chiefs of staff, presided over the meeting and told the boys he was proud of their work. Securing desirable apprentices is no problem in *his* plant.

¶ Information for Asking

FROM time to time attention is called editorially to the publication of catalogs by manufacturers of various types of foundry equipment and accessories. Needless to say, these catalogs represent the expenditure of considerable thought, time and money. What is more important, they embody the results of numerous tests and investigations of industrial products. The value of these results are attested by the incorporation of much of the data into the numerous reference or handbooks relating to the various branches of engineering. A man may be too busy to read a catalog all the way through, but a synopsis presented in the business papers shows him the principal features and a minimum amount of effort on his part will bring the book to his files.

THIS fact alone should be incentive to make the reader obtain these catalogs and keep them in an accessible place for reference. However, he may say that he can obtain plenty of data from the previously mentioned handbooks.—But can he?—Many times the answer is no, because although every effort is made to keep the handbooks up to date, it hardly could be expected that they can be revised every year.

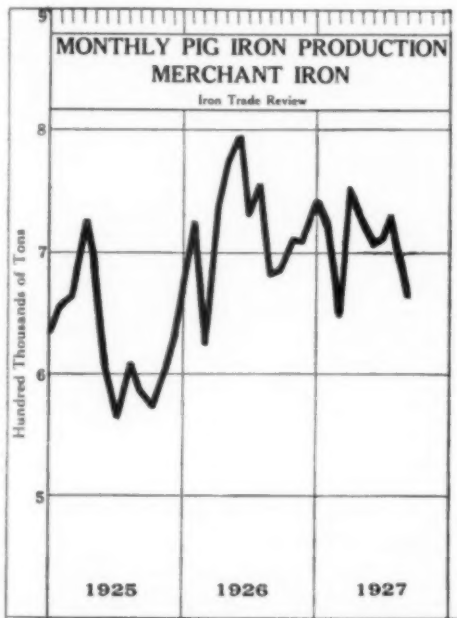
CONSEQUENTLY, to be conversant with the latest information on foundry equipment and accessories, the reader should watch for publication notices of new catalogs and write for those that interest him. In time he will have a file of valuable information that will supply data for replacing obsolete equipment, mechanicalizing his foundry or making other contemplated changes to accommodate new work.

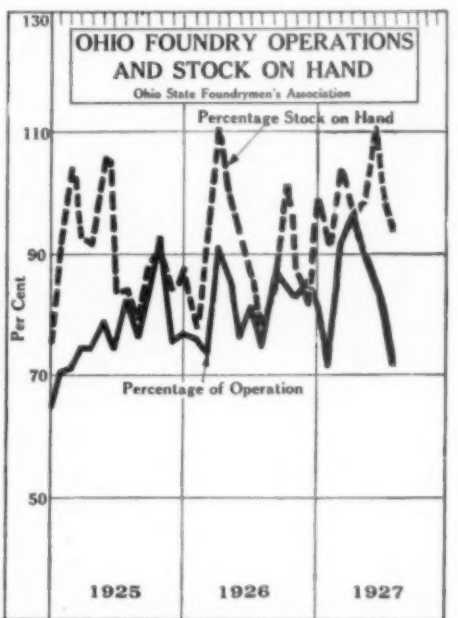
Trade Trends in Tabloid

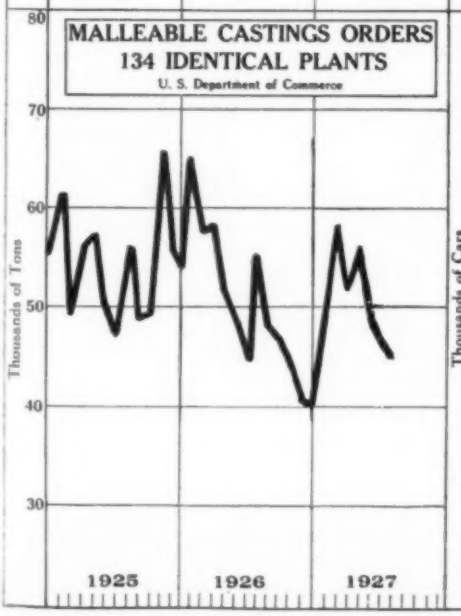
SUMMER dullness has carried over into the early fall, according to reports from jobbing foundry interests. Inquiries which normally are increasing at this time, covering September and October deliveries, are light. Unsettled conditions in the automotive industry have had a disquieting effect upon special casting requirements. What follows the introduction of the new Ford car will exert a strong influence upon this branch of the foundry industry. Malleable demand which depends for perhaps 50 per cent of its tonnage upon automobile builders, also has been affected by the state of sales in passenger type automobiles. Pig iron production in August approached the total for July, according to *Iron Trade Review*. The total for last month was 2,950,674 tons compared with 2,954,625 tons for July. Merchant iron output declined showing a total tonnage of 667,104 for August, compared with 736,707 for the preceding month. One merchant stack was blown in and two went out of operation during the month of August. Average New York prices for nonferrous metals, for August, according to the *Daily Metal Trade*, were as follows: Casting copper, 12.964c; electrolytic copper, 13.261c; Straits tin, 64.471c; lead, 6.688c; antimony, 11.828c; aluminum, 25.375c. Zinc averaged 6.351c, E. St. Louis, Ill., at the basing point during August.

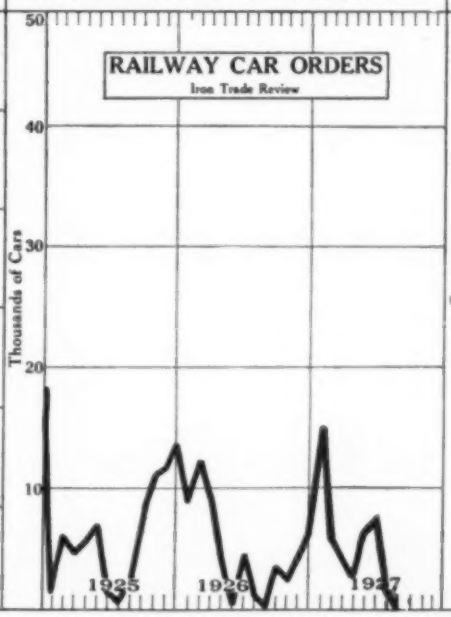
RAW MATERIAL PRICES
Sept. 7, 1927

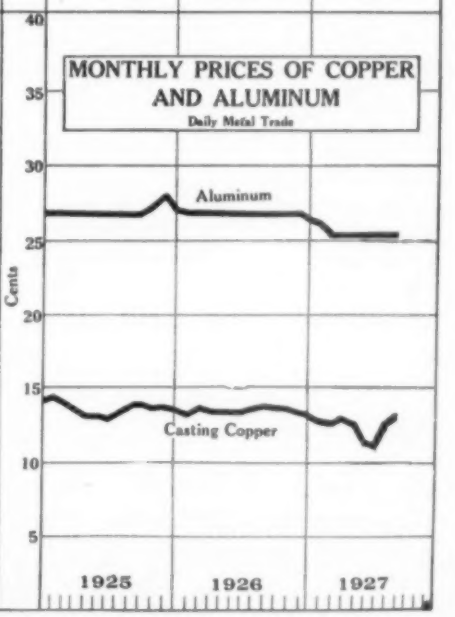
Iron	
No. 2 foundry, Valley	$17.50
No. 2 southern, Birmingham	17.25
No. 2 foundry, Chicago	19.50
No. 2 foundry, Philadelphia	20.76
No. 2 foundry, Buffalo	17.00
Basic, Valley	17.25
Basic, Buffalo	16.50
Malleable, Chicago	19.50
Malleable, Buffalo	16.50 to 17.00
Coke	
Connellsville foundry coke	$4.00 to 4.75
Wise county foundry coke	4.00 to 5.00
Scrap	
Heavy melting steel, Valley	$15.50 to 16.00
Heavy melting steel, Pitts	15.25 to 15.50
Heavy melting steel, Chicago	12.25 to 12.75
Stove plate, Chicago	12.75 to 13.75
No. 1 cast, New York	13.25 to 13.75
No. 1 cast, Chicago	15.00 to 15.50
No. 1 cast, Philadelphia	16.00 to 16.50
No. 1 cast, Pittsburgh	15.00 to 15.50
No. 1 cast, Birmingham	14.00 to 15.00
No. 1 cast, Buffalo	15.00 to 15.50
Car wheels, iron, Pittsburgh	15.00 to 15.50
Car wheels, iron, Chicago	14.00 to 15.00
Railroad malleable, Chicago	13.75 to 14.00
Agricultural Mal., Chicago	13.00 to 13.50
Malleable, Buffalo	14.75 to 15.25
Railroad malleable, Pitts	16.00 to 16.50
Nonferrous Metals	Cents per pound
Casting copper, refinery	12.75 to 13.00
Electro copper, producers	13.20 to 13.25
Straits tin	63.87½
Lead, New York	6.40
Antimony, New York	11.62½
Nickel, electro	39.00
Aluminum, No. 12, producers	24.50
Aluminum, No. 12, remelt	18.50 to 19.50
Zinc, East St. Louis, Ill	6.27½ to 6.30











Personal

HARRY E. KIES, who recently has returned from a two and one-half year stay in France where he built and put in operation a 50-ton malleable plant for the French plant of the American Radiator Co., now is executive manager, malleable iron department, American Radiator Co., Buffalo. Mr. Kies early entered the employ of the Erie Malleable Iron Co., Erie, Pa., was advanced to foreman and later became superintendent of the Erie company. In 1912, he became connected with the American Radiator Co., and was sent to Germany to complete the erection of its malleable foundry at Neuss-am-Rhein. He conducted this foundry until the outbreak of the war when he returned to America. After a short rest he supervised the construction of a large malleable iron foundry at Buffalo for the American Radiator Co. In 1921 Mr. Kies erected and managed a malleable foundry at Jamestown, N. Y. and continued operation of this plant until May, 1925, when he again became associated with the American Radiator Co., and was sent to France.

James A. Lannigan, formerly general manager, Barberton Foundry Co., Barberton, O., has been appointed superintendent of the Sharpesville, Pa., plant of the Valley Mold & Iron Corp.

J. L. Morrow, Burch Plow Works Co., Crestline, O., has been elected president of the Central Ohio Manufacturers association.

Samuel Moore has been appointed vice president of the Landon Radiator Co. Inc., North Tonawanda, N. Y. He is a graduate of Purdue university, Lafayette, Ind., entering the employ of the American Radiator Co. in sales work in the Chicago and Indiana territory in 1900. He later became associated with the National Radiator Co., Johnstown, Pa., and in 1925 returned to the American company, from which he resigned recently.

John P. Frey, has been elected secretary treasurer of the metal trades department of the American Federation of Labor and takes up his new duties in Washington Sept. 15. Practically all his adult life Mr. Frey has been a prominent figure in the union labor movement. First as an officer in the molders union, Worcester, Mass., then as one of the vice presidents of the international molder's union and for the past 25 years editor of the *International Molder's Journal*, published at the headquarters of the molder's union, Cincinnati. He has a national reputation as a debater and lecturer on labor subjects and on several occasions before and since the war has been selected by the government to accompany confidential expeditions sent to Europe to study economic conditions.

Hold Monthly Meeting

The fifth regular monthly meeting of the Wisconsin Gray Iron Research group was held at the Republican

HARRY E. KIES

house, Milwaukee, on Sept. 7. The speaker of the evening was Charles J. Scullin, manager of technical service department, St. Louis Gas & Coke Corp.

Gives Equipment Sales

A recent report of the Foundry Equipment Manufacturers association, Cleveland, gives the foundry equipment sales for July as $330,099 as compared with $507,834 for June and $454,805 for July, 1926. Shipments for July were $460,748 as compared with $555,805 for June and $494,926 for July, 1926. Orders on hand Aug. 1 were $731,649 showing a gain of 18 per cent over orders on hand July 1 of $616,056.

R. E. Malley, vice president and J. M. Jarvis, treasurer of the American Boron Products Co., Buffalo, are making a 21 day trip through the west with the American Chemical society.

Obituary

Edward Y. Moore, former president of the Chisholm-Moore Mfg. Co., Cleveland, died in his home in that city Aug. 24. He had developed a number of railway appliances, hoisting apparatus and pneumatic lifts and tools, turning later from inventions to business. With the late Judge E. H. Gary, Charles W. Schwab and others, Mr. Moore organized the Chicago Pneumatic Tool Co. in a merger of five plants in 1901, and became its vice president. He was born in Astoria, N. Y., and then lived for a while in Milwaukee. He went to Cleveland from Chicago in 1903, organizing the Chisholm-Moore company, headed now by his son, Samuel H. Moore. Mr. Moore was 80 years old.

Johnson R. Abbott, foundry owner and maker of gray iron, brass and aluminum castings under his name at Greenfield, Ind., died recently.

Charles C. Kagel, president, Kagel Bros. Co., Milwaukee, brass founder, died Aug. 6. He was a life-long resident of Milwaukee, and was 55 years old.

Frank B. Phillips, for 25 years cashier of the Bass Foundry & Machine Co., Fort Wayne, Ind., died in a hospital there after a brief illness. He was 63 years old.

William F. Pagel, president and general manager of the Turner Brass Works, Sycamore, Ill., died at his home on Aug. 5. Fourteen years ago Mr. Pagel went to Sycamore as the general manager of the Turner company. In 1920 he and his son, Herbert F. Pagel purchased the stock of the Turner Brass Works, and the former became president.

Charles Frederick Wheaton, president and general manager, Dodge Mfg. Co., Ltd., Toronto, Ont., died on Aug. 24, after a protracted illness, at the age of 68 years. He was born in Brantford, Ont., and early was associated with several business firms in Toronto. In 1883 he joined the staff of the Dodge company with the late Samuel May, and on the death of the latter, Mr. Wheaton became president and general manager. He was a member of the Engineers club and many other organizations.

R. H. McGredy has been appointed sales manager of the hoist division of the American Engineering Co., Philadelphia.

New Company Purchases Wisconsin Foundry

The Spring City Foundry Co., Waukesha, Wis., recently has been taken over by a new company which has the following officers: Wm. J. Grede, president; H. E. Blair, vice president; H. P. Kreulen, secretary, treasurer and general manager. The Spring City company has been in operation for 15 years specializing in automobile cylinders and during 1926 produced approximately 3000 tons of castings. The company also produces other automotive castings.

WILLIAM J. GREDE

Mr. Grede, president of the new company, was born in Milwaukee and attended the University of Wisconsin, Madison, Wis. After graduation he worked three years in a foundry at Decatur, Ill., and in 1920 took over the entire assets of the Liberty Foundry Co., Wauwatosa, Wis. In 1923 additional capital was secured through the incorporation and sale of stock and additions were made to the plant. Mr. Grede also will continue as president of the Liberty Foundry Inc., and the operators of the two companies will be affiliated closely.

Mr. Kreulen was born in Hengelo, Holland and served his time in the foundry of the Storks Engine Works of that city. He came to America in 1907 and was made foundry foreman of Barr & Kellerman, Chicago, in 1910. Since that time he has been foundry foreman, General Electric Co., Erie, Pa., superintendent, the Detroit Foundry Co., Detroit, foreman, the Packard Motor Co., Detroit, general foundry superintendent, the Wright Martin Aircraft Co., Patterson, N. J. Since leaving active foundry practice, Mr. Kreulen has been foundry advisor with the Charles C. Kawin Co., Chicago, and foundry specialist with the Bethlehem Steel Co., Bethlehem, Pa.

Uses Air Mail

The Beardsley & Piper Co., Chicago, recently mailed the entire edition of its house organ, *Better Methods*, to the trade by air mail as a tribute to Colonel Charles A. Lindbergh. It is believed that this is the first time in the history of the air mail that that department has been used as a means for distributing the complete issue of a house organ.

H. P. KREULEN © *Bacharach*

Foundry Association Directory

American Foundrymen's Association

President, S. W. UTLEY, Detroit Steel Casting Co., Detroit; secretary-treasurer, C. E. HOYT, 140 South Dearborn street, Chicago; technical secretary, R. E. KENNEDY, 909 W. California street, Urbana, Ill.

The Buffalo Foundrymen
Buffalo

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 146 Chandler street. Meetings the third Wednesday of the month at 146 Chandler street.

Chicago Foundrymen's Club
Chicago

President, G. H. ROLINSON, American Brake Shoe & Foundry Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co., 2563 W. Eighteenth street. Meetings second Saturday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, FRED W. STICKLE, Capitol Foundry Co., Hartford, Conn.; secretary, C. S. NEUMANN, Union Mfg. Co., New Britain, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association
Detroit

President, J. J. BOLAND, Griffin Wheel Co., Detroit; secretary, ROBERT HOPE, Holley Carburetor Co., Detroit. Meetings third Thursday in each month at the Union League club, 35 Grand River avenue, Detroit.

East Bay Foundrymen's Association
Oakland, Calif.

Secretary, H. L. MARTIN, Marchant's Foundry Co., 4401 East Tenth street, Oakland, Calif.

Metropolitan Brass Founders' Association
New York

President, WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 34 West Thirty-third street, New York.

Newark Foundrymen's Association
Newark, N. J.

President, J. L. CARTER, Barlow Foundry Inc., Newark; secretary, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by President.

New England Foundrymen's Association

President, HENRY S. CHAFEE, Builders Iron Foundry, Providence, R. I.; secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio State Foundrymen's Association

President, C. C. SMITH, Toledo Steel Casting Co., Bancroft and Smoad avenue, Toledo, O.; secretary-manager, ARTHUR J. TUSCANY, 5713 Euclid avenue, Cleveland.

Philadelphia Foundrymen's Association
Philadelphia

President, WALTER WOOD, R. D. Wood & Co., Philadelphia; secretary HOWARD EVANS, Union League club, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Southern Metal Trades Association
Atlanta, Ga.

President, GEORGE B. COCKER, Gastonia, N. C.; secretary, W. E. DUNN JR., Healy building, Atlanta, Ga.

Pittsburgh Foundrymen's Association
Pittsburgh

President, C. D. CAREY, American Steel Foundries, Pittsburgh; secretary-treasurer, WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association
Davenport, Iowa

President, HYMAN BORNSTEIN, Deere & Co., Moline, Ill; secretary-treasurer, H. A. DEANE, Deere & Co., Moline, Ill. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

Tri-City Technical Council
Moline, Ill.

Chairman F. V. SKELLEY, Tri-City Railway Co., Rock Island, Ill.; treasurer, MAX SKLOVSKY, Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association
Cincinnati

President, HAROLD P. RITTER, John A. Oberhelman Foundry Co., 3323 Colerain avenue; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association
Minneapolis-St. Paul

President, H. H. NOTT, Smith System Heating Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meetings monthly at the Athletic club.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Doran Brass Foundry Co., 75 Horton street, Seattle, plans to build a 1-story addition.

Worthington Pump & Machinery Corp., Clinton & Roberts streets, Buffalo, contemplates building a new addition to its plant.

Keystone Brass Foundry Co., 926 West Twelfth street, Erie, Pa., will build an addition to its plant.

Holmes Foundry Co., Port Huron, Mich., plant number three, was damaged by fire recently.

Electric Steel Foundry, 475 North Twenty-fourth street, Portland, Oreg., will build a storage building, shop and craneway.

N. & S. Foundry Co., 1144 Elliott avenue West, West Portland, Oreg., will build a 2-story addition to its plant.

Southern Brass Co., Chattanooga, Tenn., has been incorporated with $51,000 capital by Paul Campbell, H. J. Weeks and J. A. Sherrill.

Smithlite Castings Corp., 1010 Niagara street, Buffalo, will begin operations shortly. The firm will manufacture castings of a light alloy.

Gilbert Mfg. Co., has removed its plant and general offices from Aberdeen, S. D., to Stillwater, Minn.

Harco Steel Co. Inc., Elizabeth, N. J., has been incorporated with $125,000 capital to engage in the brass foundry business by Harry Siegel, Elizabeth, attorney.

Reliance Mfg. Co., Pasadena, Calif., has awarded the contract for its 1-story foundry, 115 x 180 feet and its 1-story machine shop, 60 x 280 feet.

Chicago Pneumatic Tool Co., Franklin, Pa., has awarded the general contract for its new machine shop and foundry to Hughes Foulkrod Co., Pittsburgh.

Higgins Brass Mfg. Co., 12435 Dequindre street, Detroit, is inquiring for complete equipment for the manufacture of brass products for its proposed 1-story plant, 80 x 200 feet.

Kingsport Foundries Inc., Kingsport, Tenn., recently incorporated, has acquired new property and plans to build a 1-story foundry and machine shop.

Morrisey Foundry, 308 West Roberts street, Crookston, Minn., has been sold by F. H. Morrisey, its manager, to J. E. Lappen. Operation will be continued without change.

Chatham Malleable Steel Co., Ltd., Chatham, Ont., proposes to build a large addition to its plant. Its steel warehouse also will be enlarged.

A. M. Norton & Co. Inc., Boston, has been incorporated with $25,000 capital, 60 shares no par value to manufacture metal castings, machinery and tools, by Leland L. Gladwin, 121 Norton street, Weymouth, Mass.

Brewton Iron Works, Brewton, Ala., contemplates building an additional unit to its plant to give the foundry and machine shop departments an increase in capacity. W. F. Wilson is general manager of the company.

Jamestown Metalsmiths Inc., Jamestown, N. Y., has been formed to take over the plant and business of the Die Cast Art Bronze Corp. It will manufacture cast metal specialties.

Booth Coulter Copper & Brass Co., Toronto, Ont., is having plans prepared for an addition to its plant by H. G. Salisbury, architect, 17 Bowden avenue. Tenders in connection with the work will be called shortly.

Atkins & Hoyle, Toronto, Ont., brass founders, are erecting a 1-story building at the rear of 88 River street. Owners are considering the installation of gas equipment for melting metals and an overhead crane.

Moloch Foundry & Machine Co., Kaukana, Wis., has let contracts for the erection of a new foundry costing about $35,000. It will be 75 x 150 feet 1-story, and replace a shop badly damaged by fire some time ago. R. M. Kanik is manager.

Lymburner Brass Works, 5849 Boyer street, Montreal, Que., has awarded the general contract for a $12,000 addition to its foundry and machine shop to James MacGregor, Ltd. Architect is Hutchison & Wood, 86 Notre Dame street West, Montreal.

Canadian Westinghouse Co., Hamilton, Ont., has started work on several buildings in connection with its plant. W. H. Cooper has the general contract for addition to the East end plant, Milton avenue plant and the records building.

Herron Stove & Foundry Co., Chattanooga, Tenn., recently formed with $150,000 capital, will take over the plant of the Southern Foundry & Machine Co. and produce stove castings. Frank Herron is president and Bert Adams, vice president.

Real estate, machinery and equipment of the Standard Malleable Castings Co., Terre Haute, Ind., were scheduled for sale at receiver's sale, Sept. 13 and 14, at the plant, by S. T. Freeman & Co., auctioneers. The equipment consists of machine shop and foundry machinery.

Holcomb Foundry & Machine Works, Poplar Bluff, Mo., will start building its new 2-story foundry and machine shop, 60 x 80 feet, with a 1-story addition, 30 x 40 feet, for which the general contract has been let to the Monolith Builders Co., Kansas City, Mo.

Federal Mogul Corp., 11031 Shoemaker street, Detroit, maker of bearings, bushings, etc., has finished construction of its No. 1 plant, Shoemaker street, and will devote a considerable portion of it to precision interchangeable bearings.

On application of Karl Jack, Robert F. Newton and Carl P. Weber, large creditors of the Midwest Casting Co., Middletown, O., manufacturer of malleable iron castings, the court of common pleas, Butler county, Ohio, has appointed Robert F. Newton, as receiver of the company.

Business men of Rome, Ga., headed by Wilson M. Hardy, president of the Hardy Trust Co., are engaged in forming a company to establish a new plant to include a foundry and machine shop for the manufacture of a new type of electric stove. Temporary offices have been established in Atlanta at 233 Peachtree Arcade building.

Construction is being rushed on the new foundry for the Detroit Gray Iron Foundry Co., Detroit. One unit is nearly completed and another has been started. The first will be equipped with one 72-inch and two 96-inch cupolas, the three combined having a total pouring capacity of 50 tons an hour. This department will also be completely equipped with new machinery and blowers. On the first floor of the second unit will be installed four large core ovens. Other equipment being added includes six traveling cranes, two compressors, two blowers, sand mixing machinery, scales, cars, and various other types of foundry equipment.

New Trade Publications

INDUSTRIAL TRACK—Herbert Morris Inc., Buffalo, has issued a booklet describing advantages of its type of industrial runways, an overhead track for moving materials in industrial plants. Suspension, construction, switches and various other details are illustrated. Numerous illustrations show typical installations.

LIFT TRUCKS—Stuebing-Cowan Co., Holyoke, Mass., manufacturer of trucks for industrial use, is mailing a folder describing a type of its single-side lift truck. It is designed for use in close quarters. Its various features are indicated in illustrations.

METERS—A booklet by the Worthington Pump & Machinery Corp., New York, presents a trip through its meter plant at Harrison, N. J. Various departments are represented in the illustrations, with a few words of explanation.

FLEXIBLE COUPLING—W. H. Nicholson & Co., Wilkes-Barre, Pa., is distributing a bulletin describing its all-metal, oiled flexible coupling. Degrees of misalignment corrected by this coupling are illustrated. Details of construction and operation are shown. Installations are presented in the illustrations.

ELECTRIC MOTORS—Century Electric Co., St. Louis, has published two pamphlets describing its split phase induction and double squirrel cage induction motors. Advantages of each type are given.

ROTARY BLOWERS—Connersville Blower Co., Connersville, Ind., has issued a bulletin on two types of rotary positive blowers. It is illustrated and contains engineering data.

ELECTRIC MOTORS—Wagner Electric Corp., St. Louis, has issued two bulletins coverinig two types of motors. Constructions shown in illustrations and details are covered in the text.

ALLOY FORMULAS—Ernest G. Jarvis, Buffalo, has issued a booklet containing numerous formulas for nonferrous alloys. Data on the physical, and chemical characteristics and the industrial applications of the alloys are presented.

PORTABLE ELECTRIC HOIST—Sullivan Machinery Co., Chicago, has issued a bulletin describing its single and double-drum portable electric hoists. Numerous applications are illustrated. Adaptability and power are presented graphically. A wide range of uses is indicated.